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Castings Prepare Cement for the Nation's Building

CONCRETE, the building material which has been used since the time of the Roman Empire two thousand years ago, has been an important factor in the multiplicity of changes, both economic and material, wrought by the increasing popularity of the automobile. Dirt roads, which were almost

A large Crusher May Weigh 450,000 pounds and Will Crush 1000 Tons of Rock Per Hour

impassible during certain seasons of the year, rapidly are passing, and in their place are being built hard surfaced superhighways, many of which are of concrete. However, road building is only one of the many construction projects using concrete, for that material is used in buildings, from the modest cottage to the monumental skyscraper; in making pipe to provide sanitation for cities; for railway roadbeds; for lamp posts; for chimneys; dams; for athletic stadiums; for docks and a thousand other uses. Production of cement, which in 1925 amounted to 161,000,000 barrels, requires a wide variety of heavy machinery, such as quarrying machinery, crushers, conveyors, sacking machinery and testing machines. Much of the machinery employed in this industry is built of parts manufactured in the foundry.

Find Where Castings Can Be Sold

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Secures High Production

Fig. 1—Molds Are Made on the Machines at the Le

REGARDLESS of numerous predictions which have been made during the past few years that the yearly production of passenger automobiles had reached the saturation point, the yearly output of cars has climbed upward steadily. With the exception of three years, namely 1918, 1921 and 1924, the total number of automobiles built by manufacturers in the United States and Canada has increased each year over the total for the preceding annual period.

This remarkable development in the automotive field cannot be credited to a greater number of producing companies. While many new automobile manufacturers have appeared, a larger number have fallen by the wayside or have been absorbed by other companies, so that the total of builders gradually has diminished in the period mentioned. The increased output rather has been due to refinements that have been made in manufacturing methods. Machines and mechanical equipment have been applied to many operations that long previously were performed by hand and this application has been so successful that costs have been reduced greatly and plant capacities have been increased materially.

As proof of the development that has taken place, especially in the foundry departments of the big plants, the numerous articles which recently have appeared in THE FOUNDRY may be cited. These articles have dealt with the many improvements which have been or are being made by a number of the leading manufacturers of the country.

While foundries maintained by automobile companies have been re-designed and more equipment has been added, the influence of this increase in output has extended to many plants engaged in the manufacture of parts for auto builders. Jobbing foundries making automobile castings continually are called upon to supply a greater tonnage, and in such cases, extensive mechanical equipment has helped solve the problem. The Superior Foundry Co., Cleveland, which recently began the manufacture of motor castings in one of its foundries, furnishes a splendid example of the production that may be secured through intensive application of the latest developments in the foundry industry. Remarkable speed was attained in placing this equipment in operation, for only 22 days elapsed from the time the contract was secured until castings were being poured. In this period the installation was designed, orders for the equipment placed, mechanical equipment received and assembled and the entire unit synchronized for smooth operation.

A brief description of the system as a whole will make it easier to grasp the features of the

With Conveyor System

By Frank. G. Steinebach

e Le[illegible]d Then Are Placed on the Power Conveyor in the Center

various parts of the unit as they are discussed separately. Conveyors are of prime importance in the operation of this system, for molds are carried from the molding machines to the pouring department and then to the shakeout. The sand is carried from the shakeout through the reconditioning processes and to the storage bins. The weights, the cope and drag flasks are returned to their respective starting points. All these transfers are handled on some form of conveyor and in the near future additional equipment will be installed to carry the castings from the shakeout to the cleaning department.

The department making gear cases is located in a large brick building approximately 90 x 400 feet, which formerly was devoted to the manufacture of piano plates. The molding, pouring, shakeout and sand equipment are placed in the center of the building, while the core department is maintained at one end and the castings are cleaned and prepared for shipment at the other end of the building. Special attention was paid to the layout of the various departments so that the materials do not backtrack as they are changed from the raw material to the finished product.

Molds are carried through the cycle of operations on a power conveyor built in a rectangular shape. This conveyor is 80 feet long and 16 feet wide and stands about 18 inches high. A general idea of the conveyor and the method of operation may be gained through a study of Figs. 1, 2, 3 and 4. The conveyor consists of a chain which operates over large sprocket wheels at the four corners of the system and is driven by an electric motor through a series of gears and the sprocket at one corner. Part of the driving mechanism is shown in the background of Fig. 4. A portion of one sprocket wheel is shown in Fig. 1, while the arrangement at the pouring floor is shown in Fig. 3. Sixty-five circular iron plates, several of which may be noted in the foreground of Fig. 1, are attached to the conveyor chain and are supported on two T-rails placed about 18 inches apart and about the same distance from the ground. As may be noted in the illustration, the molds are placed on these circular plates and are carried around to the various stations.

Production possible with the unit is governed by the speed of the power conveyor, and this in turn is regulated by the number of molds that may be made, poured and shaken out by the men at the various stations. When this study was made, the conveyor was making one complete cycle every 16 minutes, or a trifle less than 4 each hour. If each circular plate holds a mold as it passes the pouring floor, this speed means

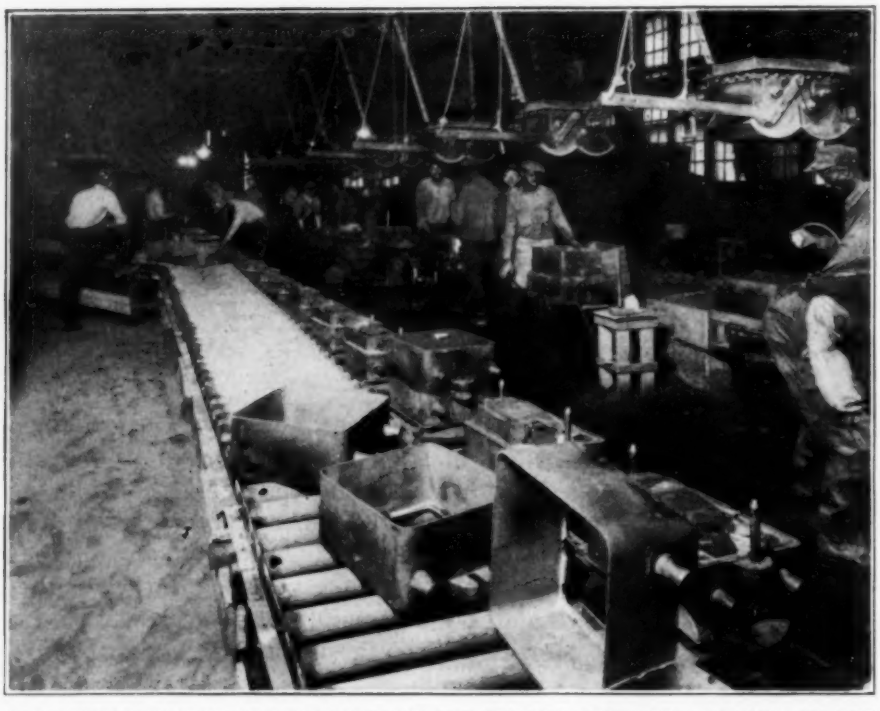


FIG. 2—COPE FLASKS ARE TAKEN FROM THE ROLLER CONVEYOR, PLACED ON THE MACHINES, THE COPE IS MADE AND THEN PLACED ON THE DRAG HALF OF THE MOLD

that 240 gear cases are produced in one hour. Since the casting with gates and risers weighs 45 pounds and when cleaned weighs 28 pounds, 10,800 pounds of metal is being poured an hour and 7720 pounds of metal hourly passes to the shipping department in the form of finished castings. The plant is producing 2000 castings in a nine hour day.

Molds are made on 12 machines placed along one side of the conveyor system in a floor space 90 feet long and 6 feet wide. Each machine operator works in a space approximately 7 feet long and 6 feet wide. The arrangement of the equipment eliminates the necessity for an operator leaving his machine. The drags are made on six machines of the hand roll-over type manufachured by Henry E. Pridmore Inc., Chicago.

Core Acts As Support

The machine operator lifts the drag half of the flask from the gravity conveyor which runs along the outside of the drag molding floor and places it on the machine. He also places one round core on the pattern stripping plate, a number of these cores being shown on the table in the foreground of Fig. 1. This core, in addition to providing one opening in the finished casting, also acts as a support for the main core which is placed in the mold in a later operation. After the molder has set the core, he pulls a lever which opens the gates on the bottom of the sand hopper, shown in Fig. 1, and allows the sand to drop into the flask. This is a measuring type gate, and only enough sand to fill the flask is allowed to drop with one pulling of the lever previously mentioned. The drag then is rammed, the bottom board is taken from the conveyor in the rear of the machine, put in place and fastened and the drag rolled over so that it rests on the self-adjusting supports which may be noted at *A* on the machines shown in Fig. 1. The pattern then is drawn and the molder starts the operation over again by cleaning off the pattern and taking a drag flask from the conveyor back of the machine.

Two men carry all of the drag molds from the platform on the machine and place them on the circular plates of the conveyor. Since there are six molders making drags, each man must make a mold for every seventh plate on the conveyor. To have the platforms on the conveyor all filled as they pass the pouring station, it is necessary that each molder make a mold approximately every 1½ minutes. However, it is not difficult for the machine operator to maintain this pace, since all operations except that of making the mold are performed by other men or gangs of men.

After the drags are placed on the conveyor, they are carried to the section of the molding floor where the copes are made. As soon as the drags are on the conveyor, one man cleans out any loose sand and places the strainer core. A second then places the main core in place, as may be noted in Fig. 1, and the mold is ready for the cope. The cores are brought from the core department in one end of the foundry building on steel racks, shown at the right of Fig. 1, by an overhead crane. Five or six racks are kept in the section between the conveyors at all times, so that no delay will follow any tieup of the crane. The cores are taken from the racks by two men, the clamps used to hold

FIG. 3—AS THE MOLDS PASS ACROSS THE END OF THE CONVEYOR SYSTEM, THEY ARE POURED BY TWO MEN. METAL IS CARRIED TO THIS FLOOR IN SPECIAL LADLES

the parts together during the drying operation are removed, the fins or rough edges removed with a file, and the cores placed on the bench, shown in Fig. 1, where they may be reached easily by the men placing the cores in the molds. The methods employed in the manufacture of the cores will be discussed later.

Copes are made on six hand stripping machines, several of which are shown in Fig. 2. The cope half of the flasks are returned to the section where the copes are made on the gravity conveyor, shown in the center of Fig. 2, and are lifted over the mold conveyor by one laborer and placed in piles at the rear of the cope machines, as is also shown in Fig. 2. The molder cleans the stripping pattern, places the cope in place on the machine and fills the flask with sand in the same manner as in making the drag mold previously described. The sand is rammed and the pattern is drawn by actuating a hand lever. Two men then lift the cope from the machine, as may be noted at the third machine from the right in Fig. 2, and carry it to the conveyor where it is placed on the drag. These two men handle all of the copes from the six machines.

Immediately before the completed molds reach the right angle turn in the conveyor system, two heavy weights are placed on each mold. These weights are dispatched from the opposite side of the system on a roller conveyor. The weights are shown in Fig. 3. After the molds are weighted, they are carried around the turn of the conveyor to the pouring station. In speaking of the conveyor carrying the molds, it must be remembered that the power conveyor is moving steadily at the predetermined rate, unless stopped because of accident, etc., and the various operations to the drag,, cope and completed mold while on the conveyor must be accomplished while the mold is in motion. However, the motion is steady and deliberate so no difficulty is encountered from that source.

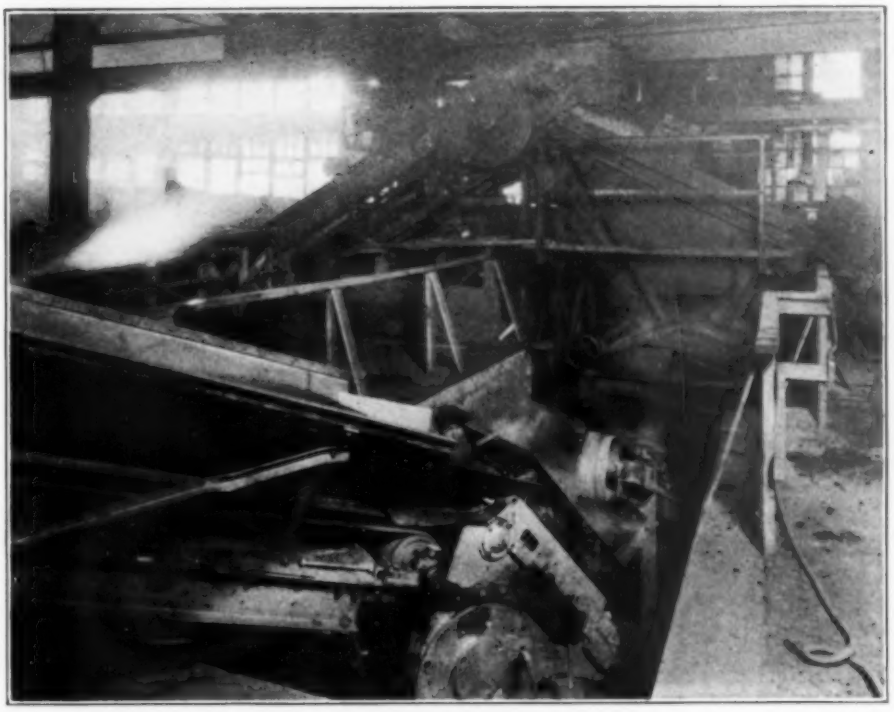


FIG. 5—AFTER THE SHAKEOUT THE SAND IS ELEVATED TO THE VIBRATION SCREEN, PASSES THROUGH A PUG MILL AND SEPARATOR AND BLENDER AND THEN IS ELEVATED TO THE BINS

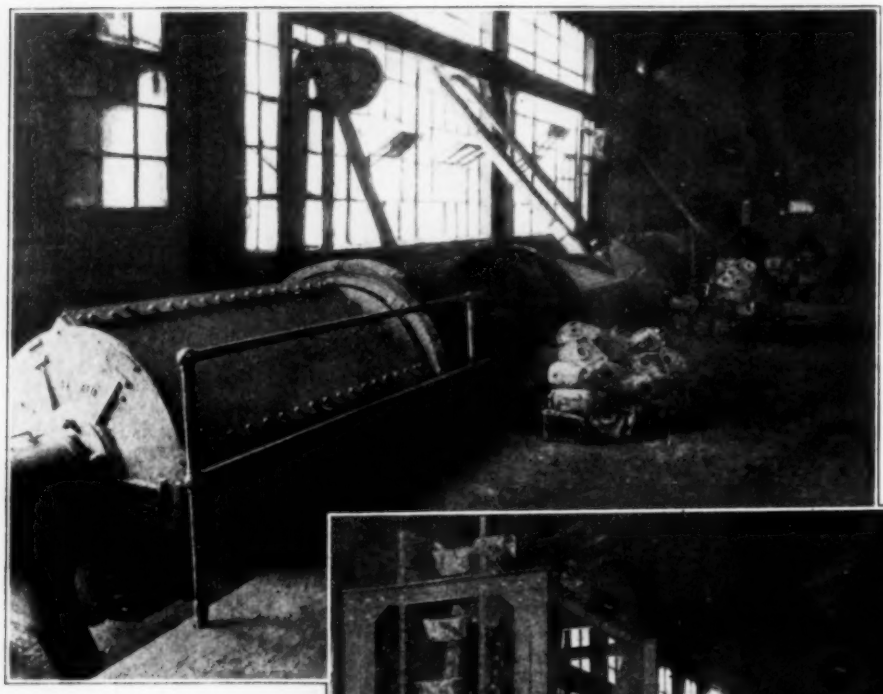
Two men, shown in Fig. 3, do all of the pouring. The metal is melted in a cupola built by the Whiting Corp., Harvey, Ill., and located in another department of the large plant operated by the Superior company at a distance of about 400 feet from the point where the molds are poured. The iron flows from the spout into 1000-pound ladles. The ladles are suspended from a monorail and each ladle is pushed to the pouring station by one man. This man operates the gear when the metal is poured from the bull ladle into the double shank ladle, shown in Fig. 3. The smaller ladle holds 150 pounds or enough metal to pour three molds.

Cooling Time Is Allowed

After the molds are poured, they are carried on the conveyor around the turn shown in the background of Fig. 3. About 15 feet beyond the turn, the weights are removed and placed on a gravity conveyor and carried to the other side of the conveyor system to the point where the weights are placed on the molds. The castings are allowed to cool while traveling approximately 50 feet from the end of the conveyor to the shakeout. About 4½ minutes are required for the mold to move this distance.

A general idea of the shakeout operation may be secured through a study of Fig. 4. As the mold reaches a position opposite the point of shake-

FIG. 4—AFTER REACHING THE SHAKEOUT STATION, THE CASTING AND SAND ARE DUMPED ON THE STEEL BELT AT THE RIGHT AND THE FLASK IS RETURNED TO THE MOLDING STATION



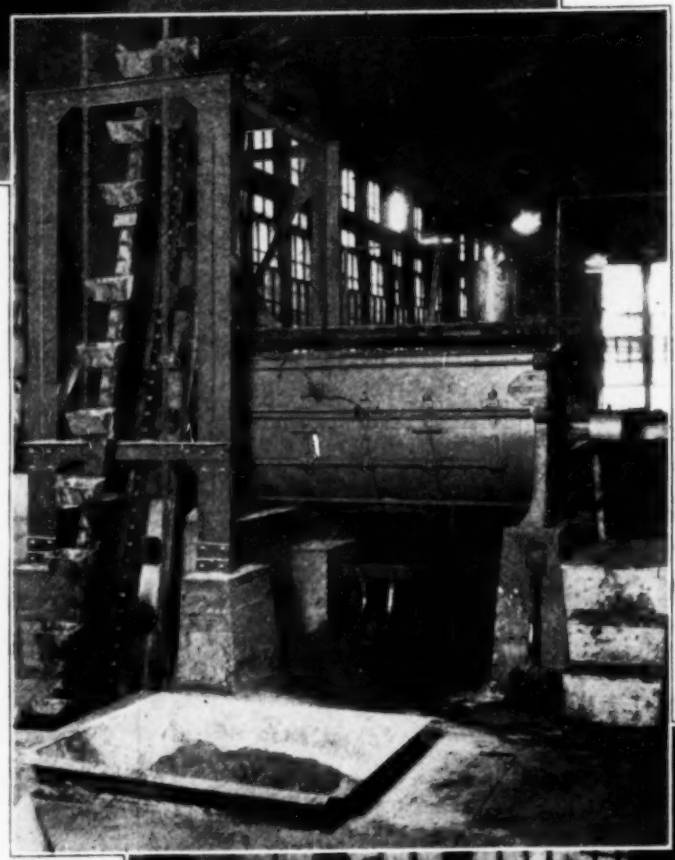


Fig. 6 (Above) — The Castings Are Tumbled in Six Large Mills. Fig 7 (Right) — An Elevating Device Is Used on the Core Sand Mixing Machine

out, the two men pick the mold from the conveyor platform and drop it upon the two plates which may be noted in the illustration. This causes the casting and practically all of the sand to fall through to the steel belt conveyor below. The two men then lift the cope flask and with one easy swing carry it back and drop it on the gravity conveyor, which is shown on the right of Fig. 4. This conveyor carries the cope flask diagonally across the section between the two long conveyor lines, and then in a direction parallel to the conveyor and along the department where the cope molds are made. Practically all of this conveyor is shown in Fig. 2. All of the gravity conveyors used in this installation were built by the Matthews Conveyor Co., Ellwood City, Pa.

Two men at the shakeout then pick up the drag flask, knock out any sand that may be left and place the flask on the same platform from which it was removed a few seconds previously. The flask and the bottom board are carried to the turn in the conveyor line where they are lifted by a workman to a gravity conveyor, which carries them to the molding floor devoted to making drag molds. A third man at the shakeout station keeps the sand and castings from jamming between the two plate supports for the mold.

Sand and castings are carried on the steel conveyor toward the incline in the rear. The castings, gates and sprues are picked out of the conveyor trough by two men provided with tongs. The castings are placed in tote boxes located behind the two men shown at the left of Fig. 4 and the tote boxes are picked up by an overhead crane and carried to a nearby point where they are allowed to cool and the cores are removed. The company plans to install a conveyor to handle this work. The castings then will be placed on the conveyor and carried to the cleaning department. While enroute the cores will be knocked out and the gates removed, so that the castings will be ready to load in tumbling barrels upon reaching that point. Return now to a consideration of the progress of the sand through the cycle of operation.

Fig. 8 (Below)—Cores Are Made in Quantities on Special Machines and Are Placed on Racks to be Hauled to the Ovens and Later to the Pasting Department

From the shakeout the sand is carried up the inclined steel conveyor, which is shown at the extreme left of Fig. 4 and also in the upper center of Fig. 5, and is dumped upon a vibrating screen placed over a hopper. The sand falls through the screen while the lumps, parts of cores and pieces of iron are carried down the inclined screen and fall into a wheelbarrow which may be noted at the right of Fig. 5. The sand falls through the hopper into the pug mill which is shown in Fig. 5. New sand, which is added in predetermined amounts by throwing it on the screen at the top of the mill, water which is added in the mill and the used sand are mixed thoroughly by the action of the paddles in the mill. These paddles also carry the sand toward the opposite end of the mill from which it entered, and forces it through an opening upon a rubber belt conveyor. This conveyor carries the sand upward and deposits it in a sand separator and blender manufactured by the Royer Foundry & Machine Co., Wilkes-Barre, Pa. The sand passes through this machine and in emerging is thrown on another belt conveyor which carries the sand a short distance and dumps it into a pit. The steel conveyor, screen, pug mill and conveyors for the sand were designed and built by the C. O. Bartlett & Snow Co., Cleveland.

Sand Carried to Bins

Sand is elevated from the pit to the distributing system above the molding floor. The overhead distributing system, which extends 90 feet over the molding department, was built by the Barber-Green Co., Aurora, Ill. The sand is carried along and is shunted into the various bins by plows which are regulated by an operator stationed on the runway above. The bins, which are shown in Fig. 1, were fabricated locally. An interesting feature of this installation is the fact that the sand passes through the system 26 times in each 9-hour working period. The sand is used a large number of times because the castings are large, thus necessitating large molds and much sand, and also because no large storage bins are provided, as is the practice in a number of other motor casting installations.

After the cores are removed, the castings are taken to the cleaning department, where they are tumbled in any of six large tumbling mills manufactured by the W. W. Sly Mfg. Co., Cleveland. The castings then are unloaded from the barrels and taken to the grinding department, where the necessary grinding is done, the castings inspected and then loaded in a car for transportation to the automobile factory. A view of four of the tumbling barrels and several piles of castings ready to be loaded into the mill is shown in Fig. 6. The gravity conveyor shown at the right will be used later to carry the cleaned castings from the tumbling mill department to the grinding department.

Since the cores are rather complicated and require care and exactness in making, considerable attention is paid to this feature of the manufacturing process. Sand for the cores is mixed with the binder and oil in a large mixer manufactured by the Standard Sand & Machine Co., Cleveland. As may be noted in Fig. 7, the sand is hauled from the storage piles nearby in wheelbarrows, and is dumped into the hopper in the floor where the binder also is added. A screw blade in the bottom of the hopper carries the sand to the bucket elevator shown at the left. The sand then is elevated and is dumped into the mixer where the oil is added and the batch thoroughly mixed. The mixed sand is discharged through an opening in the bottom of the mixer into a wheelbarrow and is hauled to the bins adjacent to the core machines, as is illustrated in Fig. 8. The sand is wheeled on a runway built about two feet above the floor level so that dumping the wheelbarrow load of sand into the bin is accomplished easily.

Cores are made on 11 jolt machines built by the Champion Foundry & Machine Co., Chicago. The cores are made in halves, dried, then pasted and dried again. The corebox for the drag half of the core has three loose pieces. The operator first sets the loose pieces in place, throws in some sand, tucks the sand in the corners and places four nails and four wires. The box is filled with sand, jolt rammed and finished by hand ramming. The plate then is placed on the corebox, the box and core rolled over and the box withdrawn. The core then is lifted to the bench, shown in the foreground of Fig. 8, the loose pieces removed and the coremaker starts on the next core. The cores are carried from the bench to nearby racks by one man. The cope is made in the same manner, although this box has five loose pieces. The vents are made in the cope with a frame, which may be seen hanging on a bench in the center of Fig. 8.

Racks filled with cores are transported to the ovens by an electric truck. After baking, the racks filled with cores are taken to the other side of the building where the two halves are pasted. The cope and drag halves first are placed in jigs which are built on a circular platform. The cores then pass under a grinder and the two faces which are to be pasted are ground so that the core is of the exact thickness desired. The two halves of the cores are inspected after they are taken from the jig on the grinder and are stacked on a table for pasting.

The pasting operation is speeded by the use of a special rig for applying the paste to the face of the core to be pasted. The rig consists of a special wire frame which fits over the core. This frame is built to touch the core in the few places where paste is desired. The frame is dipped into the paste, removed and laid on the core. It is lifted immediately and the other half of the core set in place and the two pieces clamped. In addition to cutting the time required in pasting the cores, this method also has several other valuable features. Only the amount of paste required to hold the cores is applied and the excess does not cover the vent holes which were made in the cope half of the core.

After the two halves are pasted, the core is passed down the table and two smaller cores are pasted and attached. The core then is blacked, inspected and again placed on racks. These racks are placed in the ovens by the electric truck, taken out after the paste has dried and placed in a position where the rack may be picked up by the overhead electric crane and carried to the molding floor, as previously has been described. To meet the requirements of the molding department, the core department works in two shifts of eight hours each.

Readers Comment

To the Editors:

Answering a correspondent in a recent issue of THE FOUNDRY the statement was made that so far as the editor was aware permanent molds never had been tried for the manufacture of ingot molds. For your information let me say that several years ago the attempt was made in two prominent foundries. However, the editor was correct in his assumption that molds made in that manner would not be satisfactory.

Three of these cast iron molds were made with walls about 4 inches thick. They were fitted with a runner pocket

and with lug pockets like an ordinary ingot mold flask. A tile the size of the required runner was placed in the pocket and the two halves of the mold were clamped together. Possibly 15 or 20 ingot mold castings were made in these molds.

After the third or fourth casting the molds began to check and warp. If their use had been continued the upkeep would have been expensive, but that was not the main reason why their use was abandoned. The ingot molds made in this manner did not stand up in service. Some of them cracked with the first heat. The others did not go beyond a maximum of 20 heats. They were cast from direct bessemer metal the same as molds made in the regular manner.

I have not heard of any person attempting a mold with a refractory lining. One large producer experimented with a cast iron core, carefully machined to size and shape and covered with blacking. The tricky feature of this rig was in extracting the core at the proper time. If pulled too soon, the metal would *bleed*.

If the core barrel was not pulled before contraction set in too strongly, it could not be pulled at all. Several castings with nice interiors were made in this manner. Unfortunately I have no personal knowledge of how long the molds lasted in service, but am of the opinion they did not compare favorably with castings made in sand molds. The grain of the metal was much closer than should be found in ingot molds.

Manufacturers of ingot molds carefully keep their metal within the bessemer limits and in that manner secure an open grain, tough metal able to withstand a maximum amount of contraction and expansion. Also the castings are annealed to a certain extent by leaving them piled together for a few days after they have been shaken out.

JAMES THOMAS, Dover, O.

Changed Design Reduces Expenses

By F. C. Edwards

SIMPLIFICATION of methods of production is more deserving of consideration and more likely to lead to tangible results than probably any other of the various methods suggested for increasing profits in the foundry. Not only should the manufacturing processes rigorously be overhauled, but the design of the product itself, as far as possible, should be made subservient to cheap and rapid production. An exemplification of the foregoing in which a slight alteration in design resulted in a 50 per cent saving in cost and a 66 2/3 per cent reduction in operating time, is illustrated in the accompanying illustrations. Formerly, the upper part of the finished piece *B*, Fig. 1, was cast separately and afterward bolted to the lower part of the column. The face at *C* on both parts had to be machined for this purpose. The large wing brackets *AA* Fig. 2. were cast integrally with the lower column. These brackets necessitated the use of a large core shown in dotted section which required a day to make and two days to dry. Furthermore, the subsequent handling of this core, lowering it into the mold, etc., demanded great care and skill on the part of the molder.

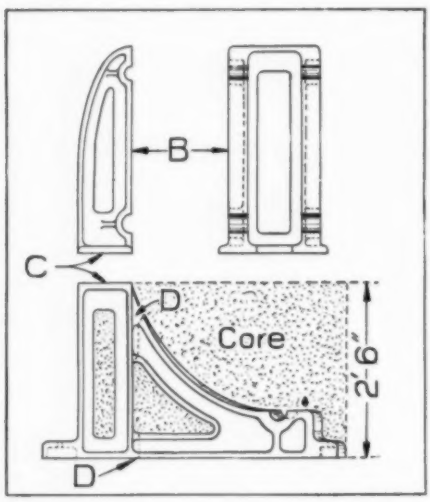


FIG. 1—FORMERLY THE UPPER PART OF THE COLUMN WAS BOLTED TO THE LOWER AT THE MACHINED JOINT *C*

A little investigation showed that the job could be greatly simplified and economies effected by changing the pattern so that the wing brackets might be cast separately and afterward bolted to the lower part of the column. With the brackets removed it was found that the upper and lower parts of the center column might advantageously be combined in one casting and thus the expense of the machined joint at *C*, Fig. 1, be eliminated. The pattern accordingly was changed by the addition of suitable flanges at *D*, Fig. 1, and corresponding facing strips on the column to receive them.

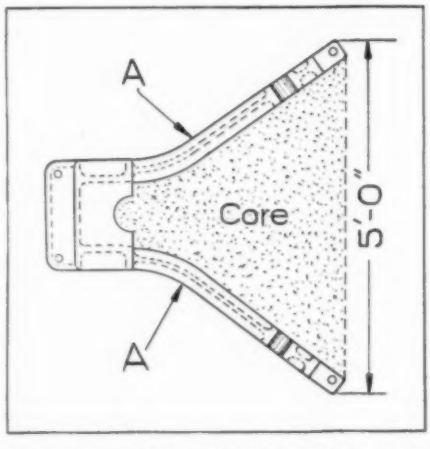


FIG. 2—A LARGE DRY SAND CORE WAS EMPLOYED TO FILL THE SPACE BETWEEN AND FORM THE INTERIOR SURFACE WING BRACKETS

The central column became practically a plain straight, casting with a plain, brick-like core, easily made and easily dried. Right and left-hand iron patterns were made for the brackets and since they were molded on their sides they required no dry-sand cores. The change in design resulted in lower production cost, better deliveries, more satisfactory castings and practically no scrap. With the changed design it was found that three complete castings could be turned out in the time formerly required for one. Another advantage, particularly as the greater part of the machines were built for export, was that in the event of a bracket being broken in transit, or in service, a new part could be supplied easily and inexpensively. Finally, the changed design eliminated any possibility of internal contraction strains.

Capacity Is Doubled

Kirk & Blum Mfg. Co., Cincinnati, designing engineer and manufacturer of pneumatic dust collecting, ventilating and conveying systems, has doubled its plant facilities through the purchase of an adjoining factory. The need for larger space has arisen through the development of the contract department which handles production of sheet metal parts for manufacturers in various parts of the country.

Marks Influence of Elements on Cast Iron Structure-I

Several Theories Concerning the Manganese-Sulphur Balance Presented—Temperature Influence on Formation of Sulphur and Manganese Discussed

By John Shaw

IT IS with a certain amount of diffidence that the somewhat heterodox views contained in this paper are put forward for consideration. The only justification for so doing is the fact that they are the outcome of 4 years' observations of the results of roughly 800 complete analyses, in which the losses or gains of each elements from the calculated analysis, after passing through the cupola, have been noted. While in some cases no definite conclusions have been reached, it is hoped that the discussion which follows will help to fix these.

It is proposed to consider the influence of sulphur and manganese on the structure of cast iron containing ordinary amounts of the other usual elements, and to deal with the influence of carbon and silicon, in conjunction with the other elements, on the structure, and finally the usefulness of various chill tests to the practical man for judging roughly the ultimate structure of his molten metal, before casting, especially if using much foreign scrap.

No analysis has been included unless there has been at least 4 tons of the same material following the tested ladle, so no contamination from a different mixture was probable. To enable the practical man to judge the structure and check these results, a chill test was used and the depth of the chill measured to the first few spots of grain showing. The test pieces were 1¼ x 4 x 6 inches molded in dry sand cores, and placed on a chill 1½ x 6 x 8 inches. After casting from a pot ladle taken from the large ladle, the test piece was allowed to stand 8 minutes, then slowly sprinkled with water, first on one side and then the other, until black hot, after which it was quenched out, broken, and the depth of the chill measured.

Not long ago nearly every ill in the foundry was attributed to sulphur. Today there is a danger of rushing to the other extreme. To quote only one authority, "A summary of most recent work goes to prove that sulphur in commercial cast irons, in the presence of sufficient manganese, exists almost wholly as the sulphide of manganese. In this form it is practically without influence on the structure and properties of cast iron." This means, if it means anything, that it does not matter what sulphur scrap contains. It does not matter if you use a high sulphur coke (for there are good low ash, good structure cokes with high sulphur), for you have only to raise the manganese content of the pig iron, and no ill effects will follow. You try this theory out on thin work and I am afraid you will be sorry.

A great deal is heard about manganese sulphur balance. Exactly what is meant? We know what is inferred. To attain this ideal condition, is manganese to be present in the atomic ratio to sulphur or 1.73 to 1, or are we to have the excess mentioned in the American car wheel specification of 3 manganese to 1 sulphur? Or need we go to the ratio of 8 to 1 found necessary by the late Dr. Stead in his experiments on mild steel, before he found all the FeS converted into MnS? What about the vital issues of time and temperature found under cupola conditions, on these reactions?

The following statements all apply either to cupola or air furnace conditions as worked commercially, and not with a cubic centimeter of iron melted in a crucible in an electric furnace and held stewing at any temperature and time desired. Once cupola metal is tapped into the ladle only a comparatively short time is available for any further reaction to take place before the metal is too cold to cast into molds. There are only about two investigations giving the internal working temperatures of cupolas. One was reported in the American bureau of mines bulletin No. 54. Coke only was used in this experiment and under these conditions a temperature of about 1550 degrees Cent. was registered.

A more recent experiment under ordinary working conditions was carried out at Sulzer Bros., at Winterthur, and published in Stahl und Eisen, June 25, 1925. Provision was made through the shell of the cupola for the insertion of platinum and platinum-rhodium pyrometers, at different levels, these results being checked by pyrometers at the same height through other holes in the shell. The highest temperature registered was 1484 degrees Cent.

These results may not be entirely reliable, owing to the difficulties encountered, but there are endless correct data with regard to tapping tem-

Presents Views

This paper is the eleventh of a series of papers on foundry problems exchanged between the Institute of British Foundrymen and the American Foundrymen's association and was presented at the Detroit convention, Sept. 27 to Oct. 1. John Shaw, the author, has been connected prominently with the British foundry industry all his life and is at present manager of the Newhall works of the Brightside Foundry & Engineering Co., Sheffield, England. In this paper Mr. Shaw presents some views of the influence of various elements on the structure of cast iron which he obtained from four years of observation of the results of nearly 800 complete analyses. Mr. Shaw was presented the Oliver Stubbs gold medal in 1924 by the Institute of British Foundrymen for his service to the foundry industry and is the 1926 recipient of the John A. Penton gold medal from the American Foundrymen's association.

John Shaw

Table I

Tests From Ladle of Special Hot Iron

	Analysis of first test Temperature approximately 1430 degrees Cent.	After 27 minutes Temperature approximately 1220 degrees Cent.
Manganese, per cent	0.36	0.37
Sulphur, per cent	0.219	0.216
Chill test, depth in inches	1⅞	1⅝

Test from a Standard Ladle

	Analysis of second test	When cool—approximately 1220 degrees Cent.
Total carbon, per cent	3.02	3.00
Silicon, per cent	0.75	0.72
Manganese, per cent	0.338	0.338
Sulphur, per cent	0.093	0.096
Phosphorus, per cent	0.48	0.47

peratures. Emmel with his specially arranged cupola and conditions, gives us temperatures up to 1475 degrees Cent., but this is not usual for ordinary work. The figure of 1370 degrees Cent. as an average given by Mr. Allison represents good ordinary practice. When this metal falls into the ladle a drop of 38 degrees Cent. may be expected. Elliott found, from a mass of data, that molten gray iron may drop in temperature from 55 degrees Cent. to 165 degrees Cent. in the time between leaving the cupola and entering the mold. From this we may assume that 1300 degrees Cent. to 1350 degrees Cent. is a good average casting temperature.

Melting point of manganese sulphide is placed variously. From a persual of published work we might think that sulphide of manganese is insoluble in molten cast iron at the temperatures commonly found in cupola work. The melting point most generally accepted is the one advanced by Rohl in his Carnegie research for 1912. He placed this at 1620 degrees Cent. McCance agrees that this figure is the most reliable, and attributes the lower figures obtained by other workers to the presence of manganese oxide dissolved in the sulphide.

Rohl's research has not received the attention it merits. Some of his results fall into line with what is found in practical work. A copy of his FeS-MnS diagram is shown in Fig. 1. He states:

The diagram FeS-MnS falls into two simple systems. The first between FeS and a compound $Fe_2Mn_2S_3$ with 60 per cent FeS and 39.75 per cent MnS; and the second between this compound and pure MnS. There is evidence that at about 60 per cent FeS a chemical combination takes place between the FeS and MnS, giving the above formula $Fe_2Mn_2S_3$, with a melting point of 1360 degrees Cent. and that an unlimited solubility exists between this compound and an excess MnS, even in the solid state present in the melts. A continuous series of mixed crystals accordingly exists between the combination $Fe_2Mn_2S_3$ and the final member MnS, these mixed crystals differing thermally from each other in the fact that their freezing point always is shifting higher, reaching and exceeding, with a percentage of 30 per cent FeS, the freezing point of pure iron.

Röhl also claimed that the reaction Mn + FeS = MnS + Fe is reversible. Although this was not accepted by McCance, a recent paper by Herty and True, before the American Institute of Mining & Metallurgical Engineers, confirms Röhl's finding. The summary of this paper states. "The results show that manganese sulphide, even in the presence of an excess of manganese, will be converted into iron sulphide and enter the metal, therefore the reaction is reversible."

These points have been stressed because it generally is accepted that even under cupola conditions there is a distinct loss of sulphur. Nearly every text book on the subject definitely states this. To quote only two —"A high manganese content in cast iron is desirable, chiefly because it operates favorably in diminishing the sulphur content. This property of manganese renders it possible to free *liquid iron in the ladle* from a considerable portion of its sulphur content." Again, "In ordinary practice considerable manganese is lost through sulphur in the mixture combining with the manganese to form manganese sulphide, which passes off in the slag."

While it is accepted that under favorable conditions this reaction does take place with the results claimed, perhaps the best example being the loss of sulphur in the large metal mixers at steel works, where both time and temperature play a part, but more especially the line and ore additions which create a favorable slag, we have never found much loss of sulphur under ordinary foundry conditions by raising the manganese. Little or no difference in the sulphur content is noticed in a test from a hot ladle quenched at once, and another when the iron is as cold as possible.

A paper by Meierling and Denecke recently has appeared in Giesserei Teitung, April 1, 1926, a summary of which follows:

> In the case of strongly overheated irons a quite perceptible desulphurization occurs after a definite drop in temperature, and is due to segregation or solidification of mixed crystals rich in iron and manganese sulphide.
>
> Desulphurization occurs not only with high sulphur alloys but also in cast irons having a normal sulphur content.
>
> In thickly liquid cast irons there is no desulphurization, because the manganese and iron sulphides which form are prevented from rising by the viscosity of the bath.
>
> No effect of shaking the bath on desulphurization could be found.

In the first case a drop of sulphur from 0.216 per cent in the first ladle to 0.122 per cent occurred after decanting into other ladles ten times from a good height. Even in the third result the metal was decanted nine times, proving at least that at first a fair temperature was attained. The whole paper is useless because no data are given as to furnace tapping temperatures, or even the final casting temperatures.

However, to try this out we repeated experiments that had been done a number of times, using a metal of about the composition mentioned in the paper. We charged a small cupola with a suitable iron. To obtain a high cupola temperature, a slight excess of coke was used, and about 448 pounds of iron tapped out in the ladle to insure a warm ladle and hot bed. This iron was poured into pigs. The ladle then was filled with 900 pounds of hot iron, approxi-

Table II

Comparison of Air Furnace and Cupola

	Total carbon per cent	Silicon per cent	Manganese per cent	Sulphur per cent	Tons	
Air Furnace	1.820	0.080	0.075	0.145	× 9.5	
Cupola	2.920	4.250	9.400	0.033	× 3.0	÷ 12.5 Tons
Calculated	2.069	1.081	2.313	0.118		
Actual	1.960	1.120	2.070	0.115		
Difference	0.109 loss	0.039 gain	0.243 loss	0.003 loss		

mately 1430 degrees Cent., and a test taken. It was held for 27 minutes, and was then as cold as would enable the metal to leave a nearly clean ladle. A second test then was taken. The resulting data are given in Table I. These results are in line with previous work. The metal was hotter than generally is found in foundry practice, and was at the finish as cold as suitable to run ordinary castings.

It is difficult to estimate what takes place in the cupola, owing to so many possibly varying conditions, but for four years, we have had the gain or loss of each element between the calculated and actual result from the first ladle, at least twice per week. For our first two or three ladles we know the analyses of all the materials composing the charge, even the scrap, which is the return from a previous cast. A test is taken from the first ladle of metal and as at least one or more ladles of the same mixture follow, we know no contamination is probable. *The manganese and sulphur loss or gain given* was actual *not percentage.*

Manganese Loss Varies

Taking these returns out for 1924, 83 complete estimations for gain or loss had been made. Neglecting the carbon, silicon and phosphorus results, it was found the loss of manganese between the calculated and actual varied between 0.09 to 0.23 (the greater loss always took place the higher the manganese charged, irrespective of sulphur), while the sulphur gain did not vary much, 0.034 to 0.038. To obtain an exaggerated view, all returns where the manganese loss was 0.2 and over were taken and the sulphur content placed alongside. These numbered 21. The returns with a manganese loss below 0.12 with their sulphur gains were next compiled; these numbered 15. The sulphur gain in the first case was 0.038, in the latter 0.034, easily within analytical error. While on the subject of sulphur it would be as well to give a warning against expecting anything like true results by employing the evolution method on cast irons with sulphur 0.1 per cent or over; no returns received have ever been within 20 per cent from any source.

While the cupola figures are open to question, even if they do extend over 12 months, due to slag conditions and varying sulphur in the coke, certain experiments carried out in the air furnace will stand examination. We make a fair amount of special low carbon iron for diesel engines and similar work. This is used in both in England and to a greater extent on the Continent. This specification is fairly stiff, not so much in the margins allowed, but in the low and high range asked for. The specification in one case runs total carbon 2.0 to 2.5 per cent, silicon 1.0 to 1.3 per cent, manganese 2.0 to 3.0 per cent sulphur as high as possible, phosphorus below 0.4 per cent. To reduce the carbon in the air furnace, much of the manganese and silicon go with it. To bring back these elements to meet the specifications, FeMn and FeSi are melted in a small cupola. This metal is added to the large ladle when tapping the air furnace.

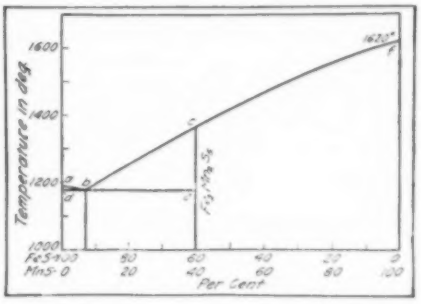


FIG. 1—ROHL'S FeS-MnS DIAGRAM

One example worked out as follows: Three tons of the alloy metal were taken from the cupola and poured into the large ladle receiving the air furnace metal. This ensured a good mixing. The large ladle was lifted out of the pit and the iron run into pigs. Time from tapping the air furnace to the solid pigs may be anything up to 30 minutes. As the manganese to sulphur ratio in this case was about 16 to 1 a fair loss of sulphur would be expected under these conditions.

Tests were taken from the metal as it ran down the spout, to get a fair average of the air furnace metal. Tests also were taken from the alloy ladle, from the ladle when the two metals were mixed, and drillings from the first, middle and last beds of pigs. In addition the analysis was checked by the customers. On weighing all up it was found the cast and runners weighed 28,000 pounds, and as 6720 pounds were taken in the alloy ladle this left 21,280 pounds for the air furnace alone. This air furnace and cupola metal data are given in Table II.

Sulphur Varies Through Section

All the variations are easily within analytical error, except manganese, which is accounted for by the oxidized state of the furnace metal. It might be thought the easiest way to settle this question would be to take a test from the ladle as soon as tapped, and afterward test the casting, but those of you who take samples from ingot molds know well that both sulphur and phosphorus are much higher at the top end, even when a head of 6 inches has been cut off. The following is an example taken from the body of a roll, where any floating material you would take for granted had passed up into the head, yet the manganese was 0.49 per cent top and bottom; the sulphur was 0.134 per cent at the bottom, 0.151 per cent at the top; while the phosphorus was 0.225 per cent at the bottom and 0.275 per cent at the top. These results have been confirmed by the investigations of Walter, Emmel, Rhein and lately in a paper by Schumacher, who states

(*Continued on Page* 771)

Table IV

Analyses of Rolls and Blocks

	Roll No. 1	12-inch Block	Roll No. 2	12-inch Block
Total carbon, per cent	3.06	2.96	3.24	3.16
Combined carbon, per cent	.....	0.55	.....	1.37
Silicon, per cent	0.50	.....	0.83	.....
Manganese, per cent	0.42	0.42	0.24	0.27
Sulphur, per cent	0.093	0.089	0.161	0.164
Phosprorus, per cent	0.45	.....	0.50	.....
Chill test, depth in inches	2 1/8	2 1/8	1 3/8	1 3/8
Roll, depth of chill in inches	7/8	3/4	7/8	7/8
Loss, depth of chill in inches	1 1/4	1 3/8	1/2	1/2
Ratio	4:1	4:1	1.5:1	1.5:1

Table III

Typical Analyses of Chill Rolls

T.C. per cent	Si. per cent	Mn. per cent	S. per cent	P. per cent	Chill test depth in inches	Roll chill depth in inches	Loss depth of chill in inches	Ratio of Mn to S.
3.06	0.58	0.31	0.104	0.266	2	7/8	1 1/8	3.0 to 1
3.10	0.51	0.38	0.107	0.46	2	3/4	1 1/4	3.5 to 1
2.91	0.80	0.38	0.110	0.43	1 5/8	5/8	1	3.5 to 1
3.14	0.80	0.29	0.112	0.50	1 5/8	7/8	1/2	2.6 to 1
3.26	0.66	0.28	0.164	0.51	1 5/8	1 1/4	3/8	1.71 to 1
3.34	0.70	0.31	0.198	0.53	1 1/2	1 1/4	1/4	1.6 to 1

Discussion of Micrographs

By J. E. Fletcher

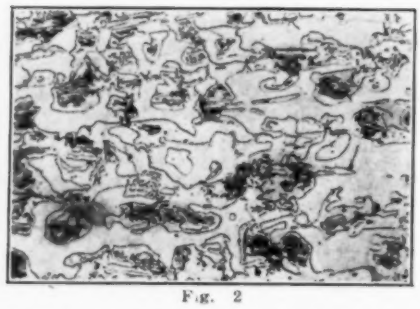


Fig. 2

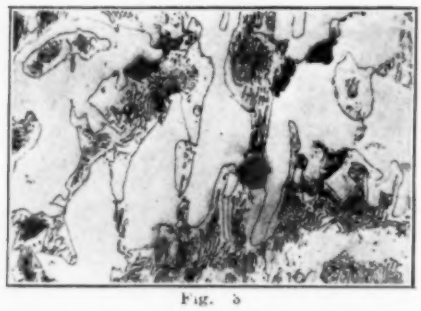


Fig. 3

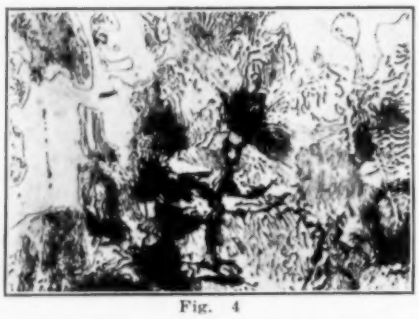


Fig. 4

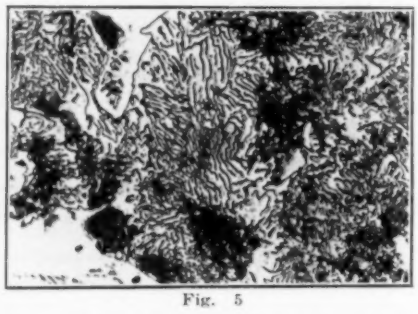


Fig. 5

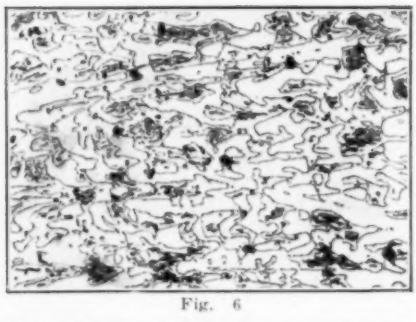


Fig. 6

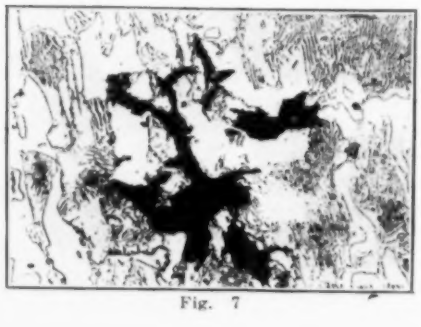


Fig. 7

Chilled Block No. 1—Figs. 2 to 5.

Fig. 2—Micrograph taken from extreme edge (chilled)—magnified 200 diameters—Picric acid etch: The columnar form of crystallization—radiating inwards from the chilled surface—is seen to persist, the structure consisting of distorted ledeburite (4.3 per cent carbon eutectic) and austenite. The C-Fe eutectic occupied most of the area primarily but has lost its characteristic honeycomb structure, only a few islands of the original austenite constituent of the eutectic remaining. Hence only the cementite of the original eutectic remains, enclosing areas of austenite which in many places are changing to pearlite. These austenite areas are the distorted portions of the first crystallites (dendrites) to solidify. They have grown by the addition of the austenite which left the ledeburite soon after its solidification. The rate of freezing has been too great for these austenite grains to pearlitize to any considerable extent. The low silicon content has been largely responsible for this and only in scattered spots has the pearlite commenced to graphitize. It is interesting to note that at these graphite spots, or adjacent to them, small specks of sulphide—a darkened dove tint suggestive of manganese sulphide—are found. There is little trace of the phosphide eutectic in the areas next to the surface—it appears to have been squeezed into the portions in the rear of the chilled zone. Where it can be traced the phosphide eutectic is near to the spots of graphite and sulphide. The fineness of the structure next to the chilled surface in this microphotograph should be noted.

Fig. 3—Microphotograph taken 7/8 of an inch from chilled face of block, magnified 200 diameters: The greatly increased grain size is evident but the same character of structure as in No. 2 persists. There is more pearlitizing of the austenitic areas enclosed within the now corase cementite skeleton. The still occasional graphite nodules are larger than in No. 2 and the sulphide areas (tint as before suggestive of MnS) are larger and of the angular form associated with MnS. In some areas the sulphide occurs within the pearlite and, during the polishing of the specimen the sulphide spot has been partly rubbed away, revealing the striations of the pearlite underneath the sulphide. The exceptionally dark tint of some of the sulphide spots suggests alloyed mixtures of the two sulphides FeS and MnS, but these spots have the characteristic angular shape which has generally been considered typical of MnS. Small globular beads of bronze or gold coloration occur very occasionally in such irons but only traces occur in this block. They have been considered to be either FeS or the FeS-MnS eutectic referred to by Rohl and others. The bronze tint noticeable in stray areas in the pearlite and which blurs the lamellar form wherever it occurs suggests a possible colloidal FeS condition—as described by F. C. H. Lantsberry. It appears to occur always near to the boundary of the pearlite grains. The microphotographs do not bring this condition out very clearly but it can often be seen through the microscope at higher powers than 200 magnification.

Fig. 4—Microphotograph taken 1¼ inches from chilled face of block—magnified 200 diameters: The grain growth is still more pronounced, the cementite now enclosing larger areas of austenite which are nearly all penlitized. Both flake and nodular graphite are present in considerable quantity, the structure being now typical of a mottled fracture in the metal. The phosphorus eutectic in this, as in Nos. 2 and 3, is difficult to trace in the photographs but is found along the boundaries of the free cementite skeleton—often near to where the sulphides are visible. The actual chill finishes between the locations of the microphotographs 2 and 3. The latter shows that pearlitization of the structure is proceeding rapidly, pearlite occupying more than half the area.

Fig. 5—Microphotograph taken from gray portion behind chill—magnified 200 diameters: Here the metal is pearlitic in character. It is noteworthy that much of the graphite is in nodular form and can be generally traced to the now enlarged pearlite grain boundaries. The last remains of the free cementite skeleton (part of the decomposed ledeburite) are also visible along the pearlite grain boundaries, where they are found associated with the phosphide eutectic. The migration of the phosphide eutectic and of the sulphide or sulphides is seen in the gray areas immediately behind the chill portion, the areas of the phosphide eutectic and sulphides being individually larger than in the white or chill areas. This migration would probably occur when the austenite dendrites were still surrounded by the eutectic constituents. The rapid growth of the dendrites nearest the chill would force the eutectiferous material—in which some of the sulphide would be floating—toward the more slowly cooling metal in the rear of the chill zone. The metal being strongly hypo-eutectic (containing about 70 per cent eutectic and 30 per cent silico-iron, etc.), the pearlitic structure where fully developed is surrounded by ferrite and where not fully developed by austenite. In the neighborhood of the graphite flakes or nodules the pearlite grains are bounded by ferrite and, wherever any free cementite remains the pearlite grains are bounded by austenite and here the pearlite is not fully developed. The low silicon content, by hindering graphitization, enables the austenitic character of rapidly cooled hypo-eutectic cast iron to persist.

Chilled Block No. 2—Figs. 6 to 12

Fig. 6—Microphotograph taken from extreme edges (chilled), magnified 200 diameters: This has similar characteristics to those of microphotograph of Fig. 2 of block 1. The higher total carbon content has resulted in a finer crystalline structure but there are more numerous specks of graphite and sulphide.

Fig. 7—Microphotograph taken ¾ of an inch from the edge—magnified 200 diameters: Grain growth is evident. Pearlitization has almost reached the extent shown in microphotograph of Fig. 3 of block 1. Occasional star-shaped flakes of graphite occur in this zone and indicate that the boundary of the chill zone is being approached. The sulphide specks are still small and the areas of phosphide eutectic—attached to the free cementite skeleton—are small and ill defined.

Fig. 8—Microphotograph taken from point ¾ of an inch from edge—magnified 200 diameters: Grain growth continuing. More graphitization and formation of pearlite. Size of sulphide specks increasing. More phosphide eutectic visible and in larger individual areas. Graphite is of flake type and pearlite is of rather coarser type than that in block 1. There are occasional rounded globules of bronze tint suggesting presence of FeS or MnS-FeS alloy. One is seen near the center of the microphotograph. Most of the sulphide specks are of the angular form representative of MnS.

Fig. 9—Microphotograph taken 1¼ inches from edge—magnified 200 diameters: Pearli-

tization increasing and so is the graphite—in flake form. Structure is typical of mottled roll metal. Sulphide spots are still larger than in microphotograph of Fig. 4 and there are odd spots of the bronze tinted constituent—always rounded and sometimes drawn out into the form of elongated pears—suggesting plasticity at time of solidification.

Figs. 10, 11 and 12 taken from interior gray portions—magnified 200 diameters: Phosphide eutectic bounds many of the pearlite grains and there is evidence of much ferrite where graphitization has been greatest (Fig. 10). Size of sulphide spots tending to increase (Fig. 12). Phosphide eutectic occurs in grain borders and in greater bulk. (See Fig. 11.) It has been noted that the dove colored sulphide inclusions often show a dappled or lamellar appearance at higher magnification—suggestive of eutectic structure. In some cases the sulphide inclusions are of dark brown or brown-black tint and are then of angular shape and at higher powers show the dappled or lamellar internal structure above described. All these microphotographs show typical pearlitic grains.

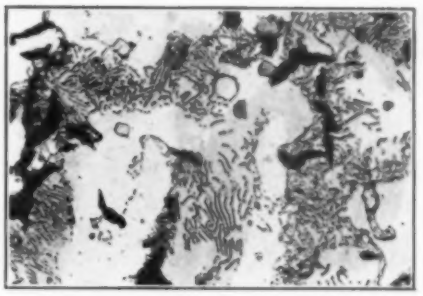


Fig. 8

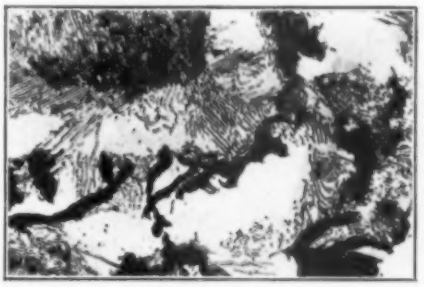


Fig. 9

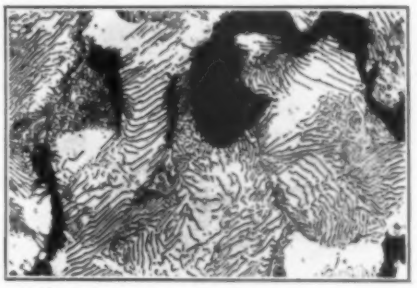


Fig. 10

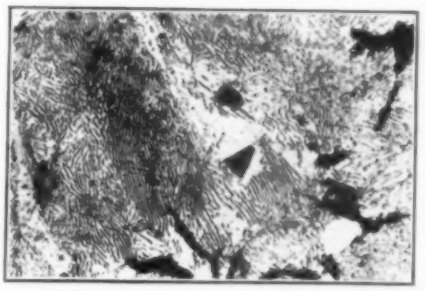


Fig. 11

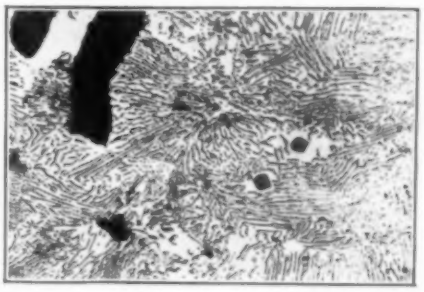


Fig. 12

(*Continued from Page* 769)

that the author found "no reduction of sulphur worth mentioning by increasing the manganese content under cupola conditions.

Following statements are open to serious criticism, but in view of the increasing use of *structural composition* and the deductions drawn from it, only good can come from a clear settlement. It invariably is taken for granted if there is an excess of over 1.73 per cent manganese to 1 of sulphur, that the whole of the sulphur is in the manganese sulphide condition, and that the remaining manganese would unite with the carbon and therefore be a hardener to that extent. There is no *quantitative* proof of these statements, either chemically or microscopically, within the range of ordinary cupola cast iron with its time and temperature limits. While etching of specimens with certain reagents or heat tinting will give certain colors, which are regarded as either FeS or MnS, these areas are so irregular that it is quite impossible to arrive at any correct figure from measuring the surface content.

The whole question is best summed up by Rohl and Law. The former states "There are practically no investigations available for the purpose of deciding whether the sulphur is combined with the iron or the manganese. It is possible that yellowish brown ferrous sulphide and dove gray manganese are spoken of. This is true insofar as ferrous sulphide in fairly large flakes generally shows a yellowish brown color, while larger enclosures of manganese sulphide appear bluish gray in incident light. It must, however, be stated that it may often be difficult to a fairly trained eye to draw conclusions from the fallow color." Law states "The sulphides occurring in steels vary much in composition and color. In some cases it is so pale in color that it is difficult to photograph, whereas in others it is so dark that it may easily be mistaken for manganese silicate." If it is so difficult to identify the various sulphides in steel, how about the complex cast iron with its fairly large amounts of other elements?

So far as the author knows, iron sulphide seldom is seen in cast iron. Even then some of the specimens put forward have not been FeS at all, the brownish blobs being due to dirty specimens not clear of the etching material, which sweats out afterward. Has too much been taken for granted that because certain patches of MnS have been identified in a sample and no FeS located, the whole of the sulphur is in the MnS condition? Most recent investigations tend to the belief that mixed sulphide usually is found in ordinary foundry iron, whether Rohl's compound or not. Acceptance of the latter view would explain the influence of small amounts of manganese in cupola metal, for not only would it reduce the manganese by less than one-half to counteract the influence of sulphur, but its low melting point of 1365 degrees Cent. is well within cupola temperatures.

As proved by the chill test, sulphur is a hardener and increases the chill. In conjunction with phosphorus it tends to give a hard face and a clearly defined chill. Manganese, on the other hand, up to the amount used in American and British practice, tends to reduce the chill and gives a more mingled background.

The typical analyses of Table III will be used for what follows. These represent rolls, all of which are of 20-inch or 21-inch diameters, so that mass action will be the same. They were all suitable for the work required, which was from tinplate to cold rolling, and each gave good service. The depth of chill of the standard test is given, but these were cooled normally. The depth of chill on the rough roll is shown, and the difference between these two is stated as loss in the next to the last column, while the ratio of manganese to sulphur is given in the last column.

That some reaction takes place between the time the metal is tapped and the solidifying of a medium roll, is certain. There is little doubt this is due to the proportion of manganese to sulphur, other things being equal. It must also be noted that in no case except the last is the manganese below the atomic ratio.

While it is true that silicon, with other elements constant, is the controlling factor for depth of chill, it

is equally certain this element is not the cause for loss of chill between the test piece and the cold roll. If so, the last analysis with its higher carbon and silicon should have lost more than the first. Although casting temperature does play a part, of which No. 2 and No. 3 of Table III may be examples, it is not a dominating feature. A definite casting temperature is aimed at, and is so near that given the right composition it does not show more than ¼-inch difference. It was suggested by a member of the staff that much of the loss might be due to the fact that the test piece rested on the chill till cold, while the roll contracted away from the round chill in about two minutes. To try this out an angle plate was cast 3 feet long by 12 inches by 12 inches inside, the metal being 2½ inches thick. This was laid in the sand and a 12-inch square block, 3 feet 6 inches long, molded in dry sand. The angle plate formed the bottom, and one side, and the mold was blacked and dried. A block was cast with each of the rolls of the compositions shown in Table IV. The first roll was 22 inches in diameter, while the second was 24 inches diameter by 108 inches on the barrel.

When the blocks were broken the depth of chill approximated to the depth found on the corresponding roll, even on the vertical side where it was expected to be less.

Through the courtesy of J. G. Pearce, director of the British Cast Iron Research association, it is possible to show microphotographs taken at intervals from the chilled edge across the sections of the two blocks. These are shown in Figs. 2 to 12 with the comments of J. E. Fletcher, consultant of that association, who examined the specimens under the microscope.

Casting Leaks Around Flange Junction

Question: The heater casting shown in the accompanying sketch has to withstand a pressure of 300 pounds per square inch. Under test we find that many of the castings leak at the junction of the flange with the body as indicated in the sketch. The mold is made in green sand. It is gated on the side of the flange. The mold is not fed, but a small riser is taken off the closed end. The iron in the casting shows a silicon content of 2.20-2.25 per cent. We shall appreciate any suggestion tending to prevent these castings from leaking.

Answer: It is rather difficult to suggest a remedy for a condition that may be due to any one, of a combination of several causes. The inquiry further is complicated owing to the fact that you do not state in what position the mold was poured. However, you do state that the casting has to withstand a fairly high pressure test and from that we feel justified in assuming that it is molded in a position that requires no chaplets to hold the core. This is possible with the print end of the core attached either to the cope or the drag, but since you further state that a riser was taken off the closed end, we naturally infer that the core was attached to the drag and the closed end of the casting was covered by the cope.

Acting on the foregoing assumption we are inclined to the opinion that your method of gating is responsible for your trouble with leaking castings. The gate delivers metal to the lower flange and as a result all the metal in the casting has to pass through the flange part of the mold. When the mold is filled, the coldest iron is in the closed end and in the upright walls. The hottest iron is in the flange. The flange is almost twice as thick as the walls of the casting and with the added advantage of being filled with hot iron remains liquid for a greater length of time. The marked difference in cooling time causes some slight segregation at the junction line between the flange and the body.

The obvious remedy is to fill the mold in such a manner that the cooling speed of the various parts of the mold is equalized as nearly as possible. This readily may be accomplished by filling the mold through a ring of pencil gates located on the closed end and fed from a circular pouring basin. Six ⅜-inch diameter gates will be sufficient.

A possibility exists that your trouble may be traced to the core. This core is almost entirely surrounded by iron and therefore it is essential that the gas should pass easily through a proper channel provided in the mold for the purpose. If the iron flutters or *kicks* from the core some of the gas inevitably will remain trapped in the iron in the vicinity of the shoulder formed by the juction of the flange with the body of the casting. This trapped gas will form a porous area through which the water will leak under pressure. To insure a free vent, the core should be made as a shell with a wall not more than 2 or 3 inches thick. It should be made from sharp sand bonded with a minimum amount of binder and baked almost to the point of scorching. If the two halves of the core are bound together firmly with a few strands of wire and if the join is daubed thoroughly, no iron will seep through to the inside.

Long Side Dirt Catcher Solves Problem

By Donald A. Hampson

The roller casting shown in the accompanying illustration presented a difficult problem for a considerable time before the present method of molding was adopted. The casting is made in several sizes and is molded on end in green sand with a dry sand core supported on chaplets on the bottom. The vent from the core is

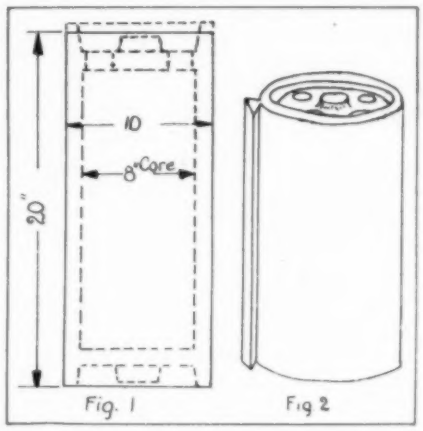


FIG. 1—LONGITUDINAL SECTION. FIG. 2—PERSPECTIVE VIEW OF CASTING WITH TRIANGULAR DIRT CATCHER IN PLACE

taken through four openings in the top. These openings afterward are plugged. The upper ring is extended ½-inch for the purpose of catching any dirt floating in the iron. This section is cut off in the lathe where the casting is machined all over.

Formerly patches of dirt seemed to catch about half way to the top and only appeared after the face of the roller was partly machined. Various remedies were tried, but without success. Finally the pattern was changed as shown in Fig. 2. A long triangular piece was attached to the pattern and the casting was poured through a bottom gate at the opposite side. This method was adopted on the theory that any dirt carried to the far side of the mold from the gate would enter the triangular chamber where it would do no harm since the piece is knocked off after the casting is shaken out. Apparently the theory is sound.

Fig. 1—A View of the Hearth Being Tapped. Note the Barrel-Shaped Pouring Ladles Used

Agitation *Improves* Iron

By C. Irresberger

Fig. 2—A 5-Horsepower Motor Geared to the Axle Supplies the Motive Power

CAST iron undergoes a certain desulphurization when conveyed in large ladles as practiced in foundries that use iron direct from blast furnaces. The decrease of sulphur easily may be proved by analysis taken first at the blast furnace and then in the foundry. It also may be noticed immediately by the smell of sulphur dioxide evolved during transportation. Opinions on the metallurgical reason of this desulphurization differ. Osann ascribes this desulphurization chiefly to the jolting or agitation caused by the shocks during transport while others attribute it to a freezing out of metalloids. Considering that heat losses only can be slight with well covered ladles and the short distance between blast furnace and foundry and heat also is supplied by surface combustion in the beginning of transport therefore, the exclusive theory of freezing is unacceptable.

Iron poured under the same circumstances in the same ladle, if left standing quietly as may occur now and then through some incident of operation, does not show any desulphurization, but cools off more quickly than the transported iron. Hence, the mechanical influence during transportation must bear on the resulting desulphurization. Realization of this action caused Dr. Joseph Deschesne, foundry engineer, to attempt a further desulphurization by a more thorough jolting and patent this procedure.

Sulphur does not occur in iron in a free elementary form. It is always in chemical combination with iron and manganese. Having a far greater affinity for manganese than for iron, it may be assumed that the greatest part of the sulphur present is combined with manganese and consequently appears as manganese sulphide. Manganese sulphide has a specific gravity of 3.6 to 4.0 and a melting point of 1600 degrees Cent. Therefore, it only can occur finely disseminated in the other elements of the molten metal, even with the highest temperatures mentioned. Because of its low specific gravity, manganese sulphide rises to the surface of the bath and will continue to do so as long the bath is liquid enough. On the surface of the bath it comes into contact with oxygen of the air and burns according to:

$$MnS + 3O = MnO + SO_2$$

As manganese oxide is acted on by carbon and silicon according to the formulas: $MnO + C = Mn + CO$ and $2MnO + Si = 2Mn + SiO_2$, another property in desulphurizing the manganese might be effected if the temperature of the molten iron bath were sufficiently high.

Slag Limits Manganese Removal

However, in practice, the combustion of manganese sulphide is limited by the resulting slag and it would not be possible to bring the freed manganese again to the state of desulphurization, due to mass effect. The law of mass effect exhibited is that the manganese in the slag has a certain relation to the manganese in the molten iron bath. If the cover of slag is kept thin and constant movement maintained by an effective method of agitation, desulphurization will take place.

The method as practiced by Deschesne, Feurstenau and Irresberger at Berlin-Spandau has justified the above mentioned suppositions. By thoroughly agitating freshly tapped iron a decrease of sulphur up to 55 per cent of the original content was obtained. Due to the agitation or jolting, the sulphur rose to the surface of the bath beneath which the sulphur content rose up to 0.50 per cent at the end of the jolting period. The hypothesis of sulphur separation is questionable as in many cases the sulphur decrease was only a fraction of the given maximum amount. The investigators are pursuing this phase further and are investigating the influence of high manganese, silicon and carbon contents, of different temperatures and varying periods of jolting.

The importance of desulphurization receded when it was realized that improvements of far greater benefit occurred from jolting which makes high sulphur content innocuous. The usual methods of improving liquid cast iron are founded on superheating to higher temperatures or on maintaining longer a good casting temperature before or after casting. No change of total carbon ensues but there is an alteration in the physical properties. By such treatment, dissolved carbides are removed and the graphite is brought to elementary solution. Undissolved graphite acts as a germ for the formation of coarse, leafy separations which affect the structure of cast iron unfavorably. If the formation of graphite germs is prevented, a much finer structure results which promotes solidity and better physical qualities.

Jolting assists materially in obtaining this fine structure which consists of a pearlitic primary mass with eutectic graphite, small quantities of ferrite, cementite, and with phosphoric iron, steadite. By jolting at a nearly unchanged temperature the carbide formation is removed, the undissolved graphite is brought to an elementary solution and the develop-

ment of graphite germs is prevented.

Another characteristic of the effect of jolting is the possibility of large steel additions without endangering the casting capabilities through sluggishness, piping or chilling white. Whether the iron contains 1.6 or 2.6 per cent silicon, 3.2 or 3.6 per cent carbon the following results are obtained; tensile strength of 42,600 to 56,800 pounds per square inch, bending strength of 71,100 to 85,300 pounds per square inch and a deflection of 0.6 inches with supports 23.6 inches apart, and bars 1.18 inches in diameter. Bars 0.6 inches in diameter under the same conditions attained bending strengths up to 163,500 pounds per square inch with deflection of 1 inch. Brinell hardness lies between 180 and 240. These figures were obtained with castings made in dry sand as well as in those made in green sand.

Jolted iron turns gray even in the thinnest sections and can be cut with a file. Ribs of air-cooled motorcycle cylinders which even when cast of iron nearly sulphur-free from the Wuest oil-fired furnace sometimes are brittle and white, remained gray, tough and could be filed when jolted iron was used. A special advantage of jolted iron is the thorough degasification which makes it less disposed to shrinkage, porosity and piping.

Steel Is Benefited

Not only can large steel additions be made to cast iron, but also liquid steel is influenced favorably by jolting especially by being deoxidized and degasified well. Thus, it is possible to produce pipeless ingots with greater security than at present, and this method may be used advantageously in producing steel castings. Figs. 1 and 2 show a jolting hearth which is in operation at the Deutsche Industriewerke, Spandau, Germany. It is constructed mainly of cast iron plates except the bottom plate which being exposed to the jolting shocks is a steel casting. The front edge of the hearth is lifted about 1½ inches by a lifting cam mounted on an axle. A 5-horsepower motor is attached to the axle by a worm gear and pinion with a gear ratio of 36 to 1. The speed of rotation may be controlled, but the most effective results have been obtained operating with 100 shocks per minute.

Fig. 3 is a cross sectional view showing the peculiar cupola spout. The spout is connected to the cupola by the narrow slit *B* which with the bridge at *A*, prevents slag from entering the hearth. The slag is removed from the cupola through the usual slag hole. The illustration also shows the open bearings at the rear part of the steel plate.

Originally, efforts were made to seal the hearth opening tightly against the cupola spout with asbestos, but as asbestos is quite friable at 900 degrees Cent., an effective sealing was impossible. However, when it was known that degasification proceeded better with an open hearth, sealing was abandoned. The surface of the bath is free from blast pressure being exposed only to atmospheric pressure.

Before blowing the cupola, the cupola spout is plugged with fat sand

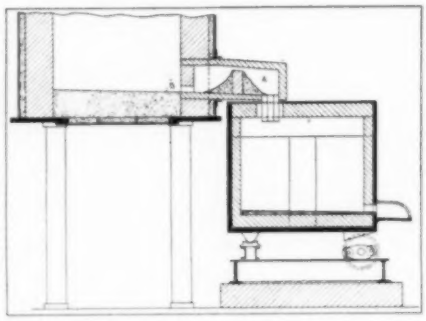


FIG. 3—CROSS SECTIONAL VIEW OF CUPOLA SPOUT AND JOLTING HEARTH

and part of the gas developed from combustion of the coke enters the forehearth by a supply pipe and escapes through the taphole, the peephole and other openings left for that purpose. As soon as the first iron appears at the tuyeres after turning on the blast, the gas supply pipe is closed and the inlet freed. When iron appears in the forehearth, its taphole is closed. In this way the forehearth is heated to nearly 1200 degrees Cent., and the iron does not undergo any appreciable chilling. Immediately after closing the forehearth taphole, jolting is begun and continued until the forehearth contains enough iron to be tapped.

It is obvious from this that the forehearth does not require any more attendance than the common type of forehearth. The spoutman only has to turn on the switch at the proper time. The cost of current for operation at Spandau at present amounts to about 1 cent per ton of metal. Since there are no other expenses outside those usually encountered with a forehearth, the improvement of iron resulting from jolting surpasses the usual methods without much added expense or trouble.

Acme Stamping & Brass Works, Zeeland, Mich., has changed its name to West Michigan Brass Co.

Equipment Arrangement for Pattern Shop

Question: We will appreciate your opinion on how to arrange the following pieces of equipment to the best advantage in a pattern shop 30 x 42 feet: One wood turning lathe 24 inches swing by 10 feet between centers, one 36-inch band saw, one 20 x 24 universal saw, one 24-inch planer, one 16-inch jointer, one disk sander, one 24-inch grindstone, one saw filer, one post wood boring machine, one 24-inch drill press, one 12-inch by 6-foot metal working lathe and two trimmers. In addition to the equipment we require room for six patternmaker's benches, four for wood patterns and two for metal patterns. We also require space for one upholsterer who needs a small sewing machine and a cutting table 4 x 9 feet. A small office space also is desirable. We do not require space for lumber storage. The lumber is stored on the second floor. We have a 5-horsepower motor and a 20-foot line shaft.

Answer: From the fact that no two shops are alike it is rather a difficult thing to say what is the best arrangement to adopt in your case. We assume that you are familiar with the layout of several pattern shops, that you have noted their favorable and unfavorable points and now wish to incorporate as many of the former as possible, and omit as many of the latter as possible, in your new shop.

The six work benches each 6 feet long and 30 inches wide are spaced equidistantly along one side close to the windows and in such a position that the light enters from the workman's left. The majority of men are right handed and prefer to work where the light comes from the left. However, that is merely a detail, the benches may be turned either way. In fact in some of the large shops where system is more in evidence than it is in the small shops, the benches are grouped in pairs, back to back.

Space for layout tables and for patterns too large to be built on the bench is provided between the benches and the line of large tools occupying the center of the floor. The remaining tools are grouped in a line in the space between the first set of tools and the wall. A 5-horsepower motor is rather light and we suggest you install a 10-horsepower motor on the wall immediately back of the grindstone. One 40-foot line shaft extending from one end of the building to the other will serve to drive all the machines.

Improve Gray Iron Properties by Heat Treatment-III

By O. W. Potter

STUDY of the microstructures in conjunction with the physical and chemical properties is a great aid to the deductions of causes for the properties and the change in properties under heat treatment. With this object in view a large number of specimens were examined both before and after heat treatment. They were examined first as polished, showing relief and then as etched with picric acid or sodium picrate. They were examined at low and high powers and the best representative structures were recorded as shown in the accompanying micrographs.

Fig. 4 shows characteristic appearance at 100 diameters of cast iron, specimen No. 25. The amount and distribution of the graphite are clearly shown but the structure of the remaining material is not resolved.

The graphite in the gray cast iron seems to be consistently in somewhat larger flakes closer together, suggesting a larger amount of graphitic carbon. This corresponds with the results of chemical analyses. The chemical analyses show in all cases a slightly lesser amount of total carbon in the semisteel with the combined carbon about the same as that in the gray cast iron. Most of the untreated specimens when examined after relief polishing show a number of light areas in relief which are evidently cementite, for example, Fig. 4, at 100 diameters. After etching, all specimens show a matrix of laminar pearlite with some patches of massive cementite and the phosphide, steadite. The gray cast iron in general, shows a greater amount of massive cementite than the semisteels as is illustrated by Fig. 1 compared with Figs. 2 and 3 which were specimens Nos. 30, 31, and 32, respectively, cast from the same day's run. The cast iron structure seemed also to be more irregular with larger graphitic flakes and with a background matrix of a rather peculiar fine grained form of pearlite interspersed with massive cementite. This is shown in Figs. 1 and 5. In the case of semisteel for example No. 31, Fig. 2, the graphite flakes are somewhat thinner, more distinct and usually occur next to massive cementite. In specimen No. 32 which was a low silicon semisteel, the matrix was a very characteristic pearlite with practically no massive cementite.

It is usually supposed that semisteel is finer grained than gray cast iron but under the microscope because of the pearlitic structure, the grain size was not evident. The microscopic examination shows that semisteels are more nearly completely pearlitic than the gray irons. The pearlitic structure is known to be the strongest form of cast iron and therefore this answers in part why semisteel is always stronger than gray iron.

Heat Treatment T-1: (Heated to 870 degrees Cent., held for three hours cooled to black in furnace in 15 minutes and then air cooled).

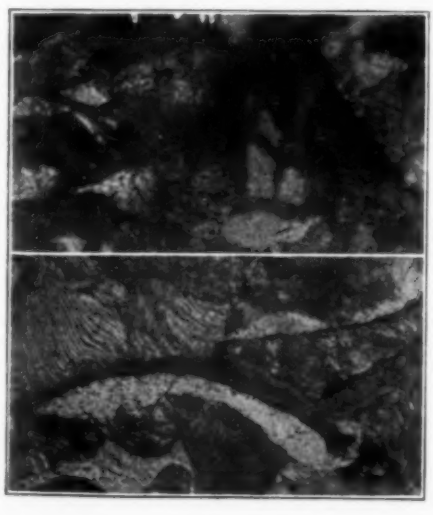
This heat treatment had a decided effect on the microstructures. Fig. 4 and 6 show the appearance at 100 diameters, of an untreated specimen and one heated according to the heat treatment T-1, relief polished. The heat treated specimen has clearly more and larger graphitic flakes. By comparing Figs. 5 and 7 etched at 500 diameters, the heat treated specimen shows a matrix with the appearance of ferrite with a small amount of cementite present; no pearlite remained. To determine if this matrix background was pure ferrite several specimens were etched for 4 hours in hot sodium picrate. Under this treatment ferrite remains unetched and appears white in relief under microscope as shown in Fig. 10. This treatment did not show these areas to be pure ferrite. Time prevented further tests to determine definitely what these areas are. It is possible that they are a solid solution of some kind, likely with silicon which occurs in considerable quantities in all cast gray irons and semisteels.

Heat Treatment T-2: (Heated to 790 degrees Cent. and quenched in water).

Figs. 8 and 9 show the specimens etched with picric acid at 500 diam-

Changes Structure

THIS is the last article abstracted from the paper read before the American Foundrymen's association at Syracuse, N. Y., by Mr. Potter. Photomicrographs of the specimens, taken before and after heat treating the cast iron, illustrate the changes in internal structure. A study of these micrographs in conjunction with the physical and chemical properties is an aid in determining the causes of the changes in the properties after heat treatment.



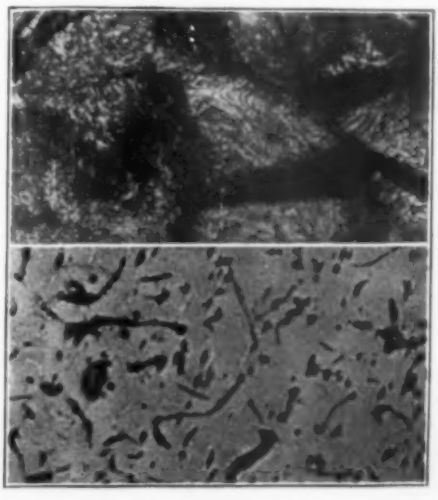


Fig. 1, Upper left—Specimen 30 C. I. Fig. 2, Lower left—Specimen 31 S. S. Fig. 3, Upper right—Specimen 32 S. S. —Magnified 500 diameters, etched with picric acid showing representative appearance of polished sections of cast iron and semisteel from same day's run. Fig. 4, Lower right—Specimen 25 C. I., magnified 100 diameters and relief polished.

eters. Fig. 9 at 500 diameters, an etched section of No. 24 S.S., shows a martensitic structure and some of the graphite in the temper carbon state. This suggests a rather hard, tough material. This is checked by the physical tests which showed a decided strengthening under this treatment. It showed a scleroscope hardness of 65 to 70.

After etching deeply, some large light areas with distinct grain boundaries appeared. These looked like pure ferrite. The focus of the microscope was changed to show which microconstituents were in relief and the order in which they came into focus was noted. They occurred in the following order: first, graphite; then martensite; and lastly, the light areas which resembled ferrite. To get further information regarding this light area, the specimen was etched in hot sodium picrate for four hours. It was then inspected at high magnification with the aid of oil immersion. Fig. 10 shows the results. This shows a small amount of ferrite almost completely enveloping the graphite flakes. Some of the areas which appeared to be ferrite on the picric acid etch are still visible but are not ferrite as indicated by the sodium picrate test. One might expect these areas to be austenite but characteristic austenite stands out in relief against martensite in a picric acid etch and this did not. Since there is considerable silicon in cast irons this constituent may be a solid solution of Si and Fe. Further tests are necessary to establish definitely its identity.

Heat Treatment T-3: (Heated to just below the critical, 735 degrees Cent. and quenched in water).

The effect of this heat treatment on the microstructure is shown by comparing Fig. 4 with Fig. 11, the untreated and the quenched specimens respectively. There seems to be more graphitic carbon in the quenched specimen. This checks with the record of tests which shows a softening and a decrease in strength when quenched from just below the critical. This corroborates the results of Forsyth and of Harper previously quoted. Fig. 12 is the quenched specimen etched in picric acid and shows a matrix of pearlite similar to that of the ordinary untreated cast gray iron.

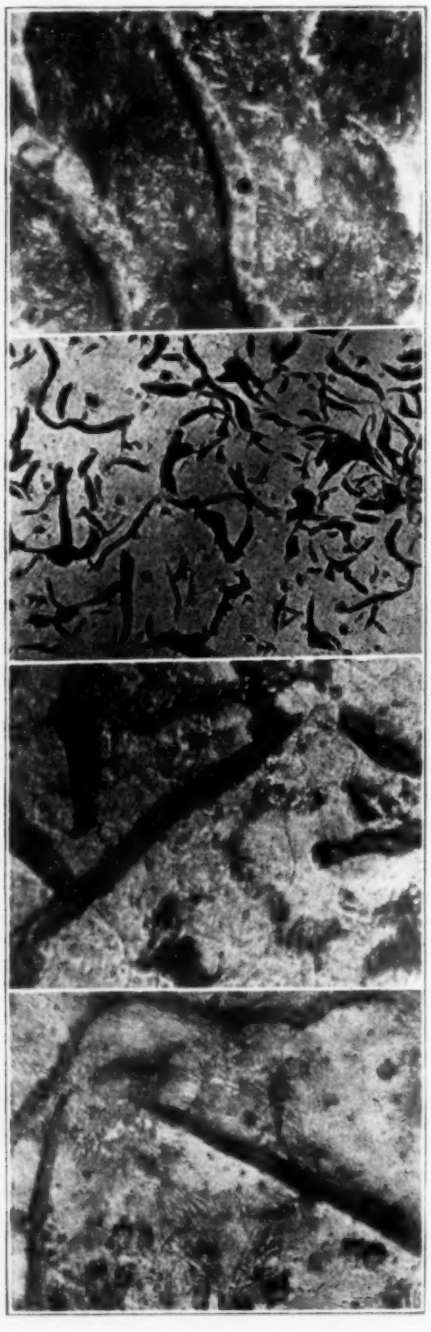


Fig. 5, Upper left—Same as Fig. 4, magnified 500 diameters and etched with picric acid. Fig. 6, Upper center. Fig. 7, Lower center. Specimen 25 C. I. given heat treatment T-L. Fig. 6, magnified 100 diameters and Fig. 7, 500 diameters. Fig. 8, Lower left—Specimen 24 S. S. magnified 500 times and etched with picric acid

Fig. 9, Upper right—Specimen 24 S. S., heated to 790 degrees and quenched in water. Fig. 10, Upper center—Same, given treatment T-2, magnified 1000 times and etched in hot sodium picrate. Fig 11, Lower center. Fig. 12, Lower right—Specimen 11 C. I. given treatment T-3. Fig. 11, magnified 100 diameters and Fig. 12, 500 diameters

Heat Treatment T-4: (Heated to 870 degrees Cent. and cooled in furnace slowly).

Figs. 13 and 14 shows the heat treated specimens to contain considerable graphitic carbon. There also is a decided tendency toward the formation of temper carbon as shown by the rounded masses in these figures.

Heat Treatment T-5: (Heated to 735 degrees Cent. and quenched in oil).

Specimens subjected to this treatment as shown in Fig. 14 show a decided increase in graphitic carbon and the retention of the pearlitic background. This is even more marked than when quenched in water as shown in Fig. 12. The records of physical test again corroborate with the microstructures in showing a decided softening and reduction in strength when quenched in oil from below the critical temperature.

Heat Treatment T-6: (Heated to 790 degrees Cent. and quenched in oil).

These specimens show evidence of the presence of some temper carbon

on relief polishing as shown in Fig. 16. When etched in picric acid and viewed with oil immersion objective at 1000 diameters there appeared graphite flakes with some massive cementite steadite, and a background of very fine grained martensite. This is shown in Fig. 17 and checks the record for hardness and physical tests which showed an increase in both hardness and strength, but to a lesser degree than for the water quenched specimens.

Heat Treatment T-7: (Heated to 870 degrees Cent. and cooled slowly in furnace, reheated to 910 degrees Cent. and quenched in water).

For this treatment specimens already subjected to heat treatment T-4 were heated to 910 degrees Cent. and water quenched. This was done to check the statement of Schaap that after annealing, quenching from above the critical did not produce white iron.

Under this treatment the scleroscope hardness was raised from original hardness of about 38 and annealed hardness of about 35 to a hardness of 71 average. The structure is not a typical white iron, however, and no typical martensitic structure appeared as in the specimens quenched from above the critical before annealing. Fig. 18 shows specimen No. 31 S. S. under relief polishing after being subjected to this treatment. There is a distinct evidence of the graphite being spheroidized.

Heat Treatment T-8: (Heated to 870 degrees Cent. and cooled slowly in furnace, reheated to 910 degrees Cent. and quenched in oil).

For this treatment specimens previously subjected to heat treatment T-4 were reheated to 910 degrees Cent. and quenched in oil. The effect of this treatment was essentially the same as for heat treatment T-7. Fig. 19 shows specimen No. 11 C. I. under relief polishing at 100 diameters. The spheroidizing of the graphite is evidenced by the small patches scattered throughout the specimen as seen in Fig. 19. The hardness on this specimen also showed a great increase of 35 to 60 scleroscope.

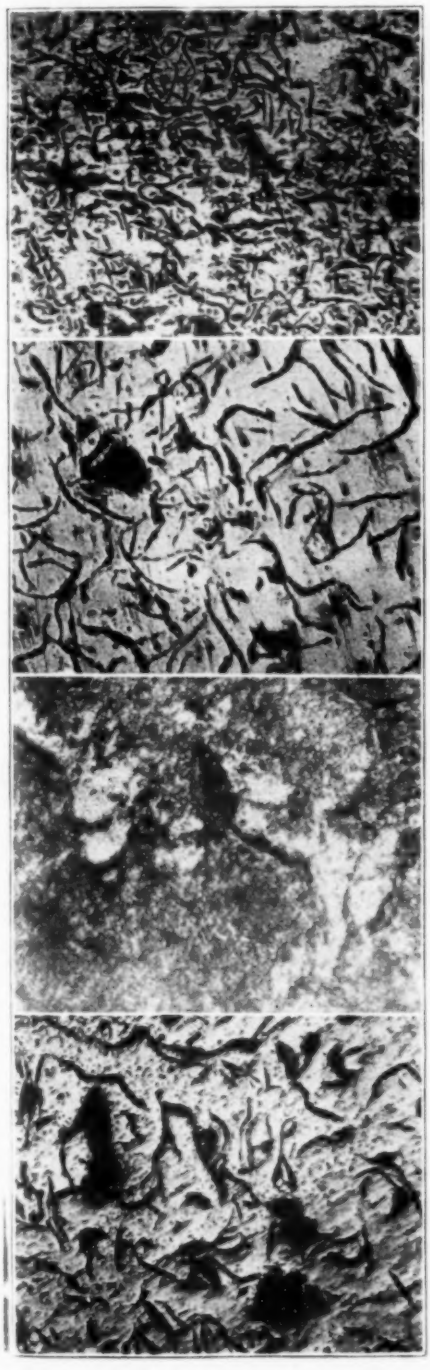


Fig. 13—Upper left—Specimen 31 S. S., Treatment T-4, 50 diameters and relief polished. Fig. 14, Upper center—Specimen 25 C. I., treatment T-4, 100 diameters and relief polished. Fig. 15, Lower center—Specimen 11 C. I., heat treatment T-5, 500 diameters, etched with picric acid. Fig. 16, Lower left—Specimen 24 S. S., treatment T-6, 100 diameters, relief polished

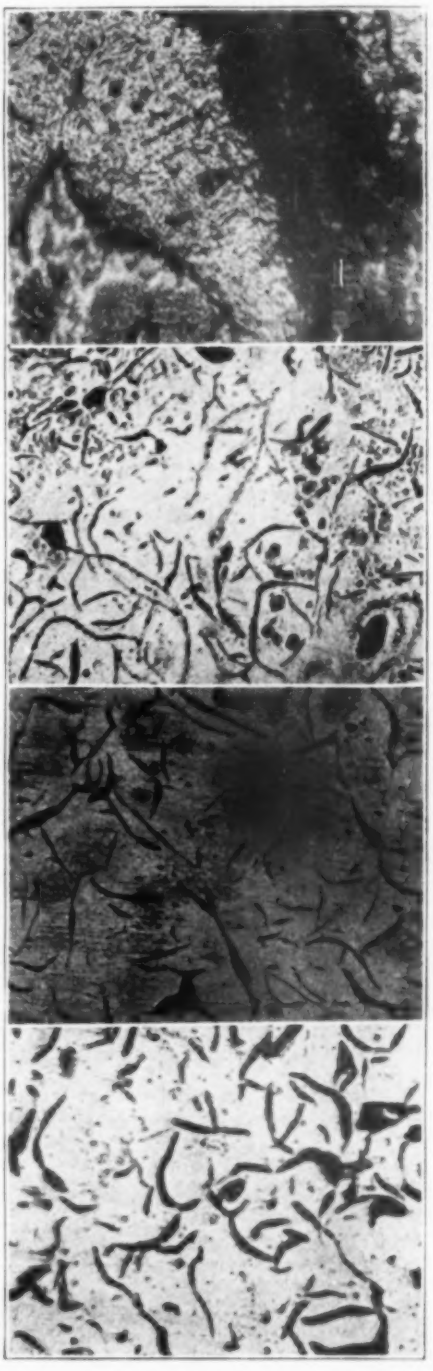


Fig. 17, Upper right—Specimen 24 S. S., treatment T-6, 1000 diameters, etched with picric acid. Fig. 18, Upper center—Specimen 31 S. S., treatment T-7, 100 diameters, relief polished. Fig. 19, Lower center—Specimen 11 C. I., treatment T-8, 100 diameters, relief polished. Fig. 20, Lower right—Specimen 23 C. I., treatment T-9, 100 diameters, relief polished

Heat Treatment T-9: (Heated to 790 degrees Cent., quenched in water and drawn at 700 degrees Cent.).

For this treatment specimens previously subjected to heat treatment T-2 were drawn at 700 degrees Cent. Figs. 20 and 22 show specimen No. 23 C. I. relief polished at 100 diameters and etched with picric acid at 500 diameters respectively. Under relief polishing the graphite flakes appeared much larger and there was also some evidence of spheroidizing. The etched specimen showed a characteristic granular pearlite in Fig. 22.

Heat Treatment T-10: (Heated to 790 degrees Cent., quenched in oil and drawn at 700 degrees Cent.).

For this treatment specimens previously subjected to heat treatment T-6 were drawn at 700 degrees Cent. The distribution of the graphite as shown in Fig. 21 is different from those untreated, Fig. 4, and those subjected to heat treatment T-9. The graphite is in small flakes and spheroidized to a considerable extent. Fig. 23 shows specimen No. 24 S. S. etched with picric acid at 500 diameters. The background matrix is granular

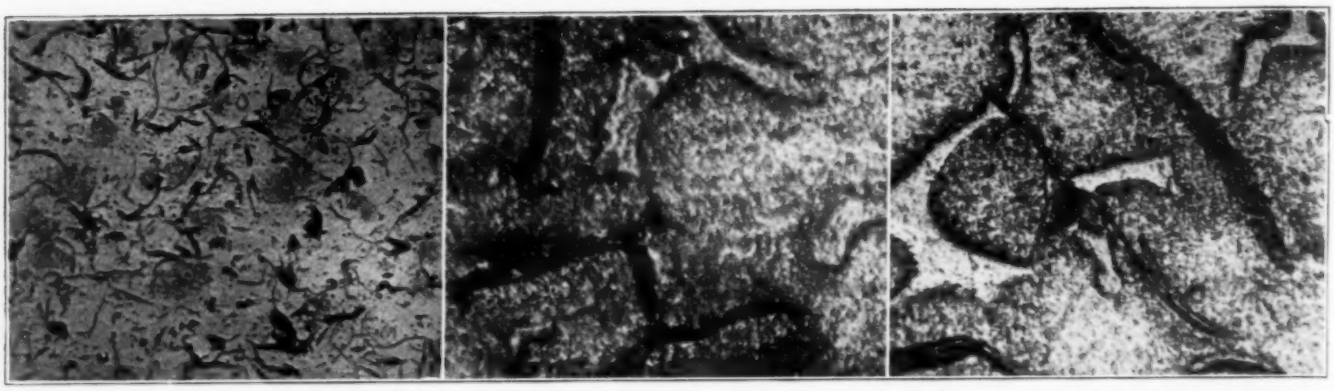


FIG. 21—SPECIMEN 24 S. S., TREATMENT T-10, 100 DIAMETERS, RELIEF POLISHED. FIG. 22—SPECIMEN 23 C. I., TREATMENT T-9, 500 DIAMETERS, ETCHED WITH PICRIC ACID. FIG.23—SPECIMEN 24 S. S., TREATMENT T-10, 500 DIAMETERS, ETCHED WITH PICRIC ACID

pearlite, the same as in heat treatment T-9.

From the results of the tests on heat treated specimens in this research, the effect on the properties seem to be about the same on either gray cast iron or semisteel.

Summing up, the effects of heat treatment can be listed as follows:

Heat Treatment T-1: (Heated to 870 degrees Cent., held for three hours, and then cooled to black in 15 minutes in furnace, and then air cooled).

Total carbon is unaffected.
Combined carbon is reduced to around 0.30 per cent (reduction of 50-75 per cent).
Hardness is greatly reduced (from 200 to 155, brinell, and from 40 to 35 scleroscope).
Transverse strength is reduced (about 15 per cent).
Deflection under transverse loading is increased.
Impact property is greatly improved.
Practically all massive cementite is removed.

Heat Treatment T-2: (Heated to 790 degrees Cent. [1450 degrees Fahr.] and quenched in water).

Hardness is greatly increased.
Transverse strength is increased (5 to 20 per cent).
Deflection in transverse is decreased.
Impact strength is increased (25 to 40 per cent).

Heat Treatment T-3: (Heated to 735 degrees Cent. [1370 degrees Fahr.] and quenched in water). Below critical.

Total carbon is reduced, probably due to surface decarburization.
Graphitic and combined carbon are reduced.
Hardness is substantially reduced.
Transverse strength reduced (5 to 15 per cent).
Deflection is increased.
Impact tends to increase (not marked).

Heat Treatment T-4: (Heated to 870 degrees Cent. [1600 degrees Fahr.] and cooled slowly in furnace).

No change in total carbon is shown.
Practically all combined carbon is graphitized.
Hardness is greatly reduced (nearly to that of ferrite).
Transverse strength is greatly reduced (20 to 30 per cent).
Deflation is increased.
Impact is reduced.

Heat Treatment T-5: (Heated to 735 degrees Cent. [1370 degrees Fahr.] and quenched in oil). Below critical.

A slight oxidation of carbon is evident from reduction of total carbon.
Combined carbon is reduced greatly.
Hardness is reduced considerably.
Transverse strength is reduced (10 to 20 per cent).
Deflection reduced slightly.
Results on impact are erratic.

Heat Treatment T-6: (Heated to 790 degrees Cent. [1450 degrees Fahr.] and quenched in oil).

Hardness is increased.
Slight reduction in transverse strength.
Tendency to increase impact properties.

Heat Treatments T-7 and T-8: (Heated to 870 degrees Cent. [1600 degrees Fahr.] and cooled slowly in furnace, reheated to 910 degrees Cent. [1670 degrees Fahr.] and quenched in water and oil, respectively).

Hardness greatly increased.
Graphite is spheroidized.

Heat Treatments T-9 and T-10: (Heated to 790 degrees Cent. [1450 degrees Fahr.] and quenched in water and oil respectively and drawn at 700 degrees Cent., 1382 degrees Fahr.)

Hardness reduced to that of original specimen.
Graphite spheroidized and granular pearlite or sorbite formed.

From the foregoing summary of effects of heat treatment it is seen that it is possible to vary greatly the physical properties through heat treatment. The temperature of heating, the time held at temperature, the rate and method of cooling are all important factors to be considered. This study has shown that certain properties of both gray cast iron and semisteel may be improved by heat treatment and they also may be ruined. A further study along the lines of this research would be a means to determine the proper heat treating temperature; the chemical composition that will respond best to heat treatment; the correct time of holding at temperature; and the proper rate of cooling. The properties desired will of course influence this to a considerable extent.

Conclusions

Proper heat treatment can improve greatly the general properties of gray cast iron and semisteel. One of the important results is a uniform hardness and the elimination of massive cementite under annealing.

To properly heat treat, the correct critical temperature must be located and the temperature carried only enough above this to insure all parts being heated above the critical. This can be determined by ordinary thermal analysis.

The critical temperature of gray cast iron and semisteel can be calculated with a fair degree of accuracy from the chemical analysis according to the following formula:

Critical Temperature = 730 degrees Cent. + (28 degrees X per cent Si) — (25 degrees X per cent Mn.)

Carbon is oxidized when subjected to a quench from just below critical.

The best combination of properties was obtained by heat treatment T-1 (heated to 870 degrees Cent. [1600 degrees Fahr.] held for 3 hours, cooled to black in furnace and then air cooled). This was the heat treatment recommended by the Schaap process. This produced a uniformly soft product with only a slight reduction in strength properties.

Holding at high temperature for long periods of time or cooling slowly from such temperature produces extreme softness, but also greatly reduces the strength properties.

To overcome the difficulty of dimensional changes, gray cast iron may be machined, and then subjected to a quench to produce hard iron which is not affected by intermittent heating and cooling below the critical.

The properties of both gray cast iron and semisteel may be varied greatly by heat treatment and the possibilities of improving and controlling these properties offer great prospects of practicability. To do this additional systematic research is necessary for the coordination of chemical composition, physical properties, and correct heat treatment along with a study of the microstructures.

Melt Steel Heats in a Cupola

In the Early Experiments a Small Quantity of Gray Iron Primed the First Tap, But This Practice Was Discontinued Under More Efficient Cupola Operation

By T. F. Jennings

STEEL scrap has been incorporated in gray iron mixture and in that form has been melted in cupola furnaces for many years. The practice is not universal and amateurs almost invariably come to grief in early trials, but a knowledge of how it is done is fairly common among experienced foundrymen. Metal produced by melting a mixture of gray iron, pig or scrap and steel in varying proportions is known commercially as semisteel to distinguish it from straight mixtures of gray iron, malleable iron or steel. Also the term is applied almost exclusively to cupola melted metal.

The term semisteel is rather indefinite since it is applied indiscriminately to any mixture of gray iron containing an addition of steel. For that reason it is viewed somewhat askance by scientists who insist on material conforming to strict formulas, specifications and analyses. Also since the carbon content of semisteel places it in the gray iron rather than in the steel classification, they claim that the term semisteel is a misnomer. This paper does not propose to discuss this controversial point. For all practical purposes semisteel has been accepted as a proper term and no doubt it will remain in foundry nomenclature until, if ever, a more appropriate term is coined.

Development of this material has been gradual over a long period of years and represents the pioneering efforts of a great number of foundrymen. It was not *discovered* by any one person in particular although several prominent men carried their investigations further than others. Instances are on record over 100 years ago of foundrymen strengthening their mixtures by the addition of wrought iron. These instances and others dealing with the subject up to modern times have been described in many papers and have been published in the technical press so there is no need at this time in presenting a review. Among the more prominent contributors on the subject are the late H. E. Diller, James A. Murphy and David McLain.

The last named gentleman probably has done more than any other man in disseminating information on this subpect among foundrymen.

Little was heard of semisteel before the early seventies when several Pittsburgh foundries tried it in their mixtures for castings requiring great strength. In the early eighties both Robert E. Masters and the late Thomas D. West contributed articles to the *Scientific American* describing their experiences in melting entire heats of steel scrap in the cupola. They claimed complete success in the actual melting operation, the metal was fluid and filled the molds readily, but the castings were hard and in the form they were poured found no commercial application. In recent years the only published material on the subject of melting entire heats of steel scrap have been confind to electric furnace operation.

Is a Past Master

ALTHOUGH for many years associated intimately with the copper mining and smelting industry, the author of this paper,

T. F. Jennings is a past master in the art of casting ferrous metals. His position as foundry superintendent for the Utah Copper Co., Garfield, Utah, has acquainted him with the problems of making various classes of gray iron castings in addition to a number of kinds of white iron which are not encountered ordinarily by the foundryman in the large industrial centers. Further, Mr. Jennings has availed himself of the opportunity afforded by travel to become familiar with the best in foundry practice. This article is abstracted from his paper which was delivered at the Detroit convention of the American Foundrymen's association.

For many years the writer has been accustomed to the continual use of steel scrap in cupola operation, from 10 to 15 per cent in light and medium weight and from 20 to 25 per cent in heavy machinery castings. A series of tests conducted over a period of many years indicate that the best results are secured from a mixture containing not over 30 per cent steel.

As stated previously instances are on record of entire heats of steel melted in the cupola, but these heats were comparatively small. Up to the present and outside my own experience I have found no record of large heats melted in this manner.

Both in the past and present vastly different opinions prevail on the proper method of charging steel in the cupola. My own practice differs from any I have seen practiced or described. "The open mind is the precursor of progress." To accept some of the fundamental principles here presented in melting steel scrap you may find it necessary to revise some of your former conceptions of cupola practice.

Pure science is based on four fundamental principles: Analysis, synthesis, imagination and absolute elemination of personal opinion. No person can say which of the four is the most important, but one in particular represents the sum total of the difference between scientific and unscientific methods.

When the average man untrained in the habit of scientific thinking approaches a problem he is swayed and influenced by preconceived opinion, prejudice, bias, habit and ignorance.

Science deals with nothing but facts, has no opinions, admits no prejudice, eliminates personal habits, analyzes to the last atom and admits nothing as a fact unless it stands the test of logical reasoning. A natural rule of action, a definite cause precedes every result.

Bearing in mind the foregoing points I approached a problem a few years ago of reducing an accumulation of approximately 12,000 tons of a poor grade of steel scrap into a commercial grade of hard iron castings. I had choice of three alterna-

tives. To build an open-hearth furnace, to install a large electric furnace or to attempt the melting of this large amount of steel in the cupola already in existence. In addition to the 12,000 tons of steel scrap provision had to be made for taking care of a considerable tonnage of steel scrap incident to the operation of a large plant from day to day, The open-hearth furnace and the electric furnace were ruled out on account of the heavy initial capital expenditure.

Attempt to use this immense amount of steel scrap by mixing it with the iron charges would not cut down the pile rapidly enough so I decided to try the problematical process of melting complete steel heats. The attempt was made in the face of a prevailing opinion that the cupola lining, any kind of a lining would not stand up to the increased temperature considered necessary for melting steel. Resulting experience seems to indicate that the majority of failures in melting steel are due to misconception on this point.

New standards had to be developed to insure a metal throughout the duration of the heat of sufficiently high temperature to stand transportation a considerable distance and pouring over the lip of the ladle. An impression prevails in some quarters that where steel is melted in the cupola the amount of fuel has to be increased over that required for gray iron on account of the higher temperature demanded. Otherwise it is claimed the metal will become pasty, set rapidly and skull the ladle. Also it is claimed that the steel absorbs carbon from the fuel, therefore the extra fuel is required to supply this carbon. Neither of these claims has been substantiated in my experience of several years in melting daily complete charges of steel scrap varying from 25 to 30 tons.

Early experiments with coke of 84 to 86 per cent fixed carbon and a high ash content showed that this coke was not capable of producing the necessary high temperature, irrespective of the amount employed. Finally I secured a coke of not less than 90 per cent fixed carbon and a low ash content. This coke produced satisfactory melting conditions and reduced the amount of slag to a gratifying extent.

We have four cupolas made by the Whiting Corp., Harvey, Ill., in our foundry and in our early experiments we melted the steel in the smaller pair lined to 45 inches. At that time the heats did not run over 15,000 pounds. At present and for the past two years we have been melting heats of over 30 tons daily for 7 days a week in the larger pair lined to 66 inches. The two cupolas are used on alternate days, one in blast and one under repair.

In preparing the cupola for a heat the lining is rebuilt or repaired to a straight line with silica split brick. The joints are made tight to prevent leakage of the gas. Several foundries melting steel were investigated in an attempt to discover a suitable lining. One was found in the Chicago district using a rammed ganister lining, but the heats were small and did not offer a fair comparison, since we were confronted with the problem of melting between 25 and 30 tons a day.

Many Lining Materials

After trying many forms of lining including ganister, magnesite and a few heat resisting cements warranted in advance to withstand high temperature and abrasion, the best results were secured from a split silica brick laid against a silica block backing.

At first we had a great deal of trouble with the slag hole. We tried chrome brick blocks, different kinds of mixtures including graphite, a proprietary cement, ganister and clay singly and in combination, but none lasted beyond the time of melting 30,000 or 40,000 pounds of metal. The hole became too large. Finally we developed a tap and slag hole formed from block silica brick with a daubing of 75 per cent silica sand, 2 per cent cement and 23 per cent good fire clay.

The first linings burned out quickly in the form of foam that came through the charging door, but we found later this was due to the manner of charging.

The hearth is well rammed with a good mixture of silica sand and molding sand. This mixture is rammed hard around the edge, but not so hard in the center. The sand is struck off flat with a fall of 1 inch to the foot from the back to the spout. Three feet of coke are placed on the wood and a mild blast is employed until the coke shows red on top. The single row of tuyeres is located 20 inches above the bottom and after the coke is burned through we add a sufficient amount to bring the top 30 inches above the tuyeres. Charging then is commenced.

Steel scrap and coke are brought to the door in cars and charged by hand up to a point 3 feet below the door sill. The remainder of the material is dumped from the cars directly into the cupola by a mechanical charging device.

Instead of the usual 3300-pound charge we cut it in two and place a layer of coke between steel charges of 1650 pounds each. We have melted 3300-pound charges, but found that the metal from the smaller charges is more conveniently handled and carries a higher temperature.

Scrap used in the charge is made up of nearly everything in the steel line, either forged, rolled or cast. Structural shapes, plates, rods, railroad scrap, rails, fish plates, bolts, either in the natural state or cut to convenient handling lengths. Chunks of high manganese, high and low carbon steel up to 150 pounds in weight are charged intact.

Competent converter steel men advised me in the beginning that the addition of high silicon content ferrosilicon in lump form was absolutely essential to raise the temperature and fluidity of the metal to a point where it could be poured satisfactorily over the lip of a ladle. Experience has shown this advice to be mistaken. The practice of using a rich grade of ferrosilicon probably ranks next to the high fuel ratio mentioned previously as the principal cause of failure in melting steel heats successfully in the cupola.

Cost of this high grade material is much higher than ferrosilicon of a lower silicon content and in that manner the expense of operation is increased beyond reason. Further, 80 per cent ferrosilicon limits production since it creates a slag that quickly eats out the lining of the cupola.

While trying the high ferrosilicon, the limit of the melting capacity of a 45-inch cupola was 15,000 pounds. After 7 months of trial and experiment we gradually cut down on the ferrosilicon and transferred the steel melting to our 54-inch and 66-inch cupolas and gradually raised the daily charge until we attained our present maximum of 62,000 pounds, sufficient for present requirements.

Under former conditions an addition of from 4 to 15 per cent gray iron pig or scrap had to be placed in the mixture at the beginning of the heat to prime it and prevent it from chilling in the tap hole. Under the conditions finally developed we use no soft iron whatever and experience no trouble of any kind with the tap or slag hole or with the lining of the cupola.

Naturally at this point the question arises what kind of metal is

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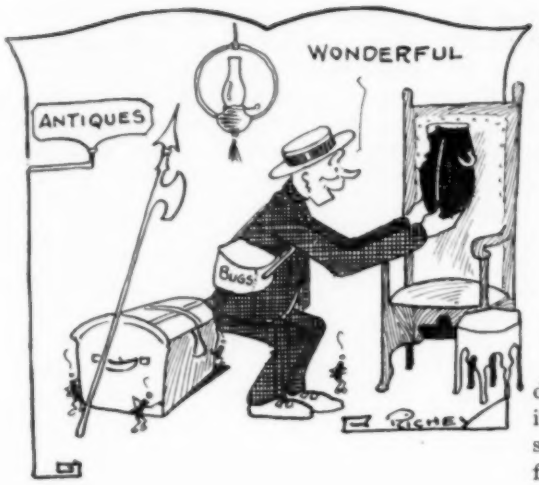


Bill Learns How Trick Castings Are Made

By Pat Dwyer

LAST night while glancing idly through the pages of a popular magazine I discovered a rather interesting article on the subject of collecting antique furniture. I have no particular hankering for this kind of junk, the furniture I mean, but I was interested in the enthusiasm displayed by this collector. The initials of the author were J. A. and although I read the text rather carefully I could not determine whether these initials stood for John Angus or Jenny Anne. I felt rather inclined to the feminine theory, but then in recent years I have read so much goofy stuff over masculine signatures that I hesitated at coming to a definite conclusion.

Perhaps I am like our Jim the only man in the band in step, but I never could understand why this collecting hobby gets such a strangle hold on some people. Their only interest in life is bound up in gathering material only fit for the junk yard. When I go to bed I want to sleep and I don't care if the bed was made in Sorrento, Italy in 1796 or in Grand Rapids in 1926. Of the two I believe I would get a better night's rest in the latter.

The same applies to old moth eaten and wormy books, which by the way the collectors never read, spinning wheels which do not run, chairs which are good for nothing but the creation of back aches, stamps which have out lived their usefulness and all the thousand and one ancient items which a beneficent Providence in its inscrutable wisdom has kept out of a merciful bonfire.

Last night when Bill came in I asked his opinion on the subject of hobbies in general. He admitted that he could not explain why some men were addicted to the collection of wives, beer steins, old pipes or cigar bands but he could quite understand how a man could be interested in carving peach stones or in making Mission furniture or in making useless doodads on a scroll saw.

"I know a lad here in town," said Bill, "Who cultivates the somewhat peculiar hobby of making odd and intricate castings in his spare time when he might just as well be out shooting golf or dice or engaged in any other of the well known methods for killing time. However, the net result is about the same. From a purely utilitarian point of view the castings are of no earthly use which of course places them on a par with a golf score. In the one case the casting is a tangible evidence of the maker's skill and ingenuity. In the other the score card truly may represent the degree of the player's skill and then again it may only represent a compromise with his conscience. When a disinterested third party sees a casting he believes implicitly the story of the man who made it. He does not have to go to the foundry and watch every step.

"Did you ever see a perfectly honest golfer, or a perfectly honest fisherman? No. You never did and you never will. There seems to be something about the great open spaces that causes members of these two tribes to forget some of the finer edges of the lessons whaled into them in their youth.

"Probably you have noted the significant fact that golf is the only game in which the players keep their own scores. For that reason the evidence of at least one and sometimes three witnesses is required before the scores are accepted. At a championship match it is no uncommon sight to see hundreds of witnesses following the players as they go around. This is officially known as the gallery and is supposed to be made up of enthusiasts desirous of improving their form by watching the expert. Without doubt they watch him. Watch him closely. Not to pick up any form, but to assure themselves absolutely that the number of strokes he makes and the number entered on the score card coincide as perfectly as the two triangles Euclid used to prate about in the first book."

"Lay off the golfers," I said, "and step softly. I shall not be surprised one of these days to learn that you have sneaked into the game yourself. The less you say now, the less you will have to retract later. What about this man who makes castings for a hobby. Who is he, what is he, what does he do for living, what kind of castings does he make and finally how do you account for such a strange hallucination?"

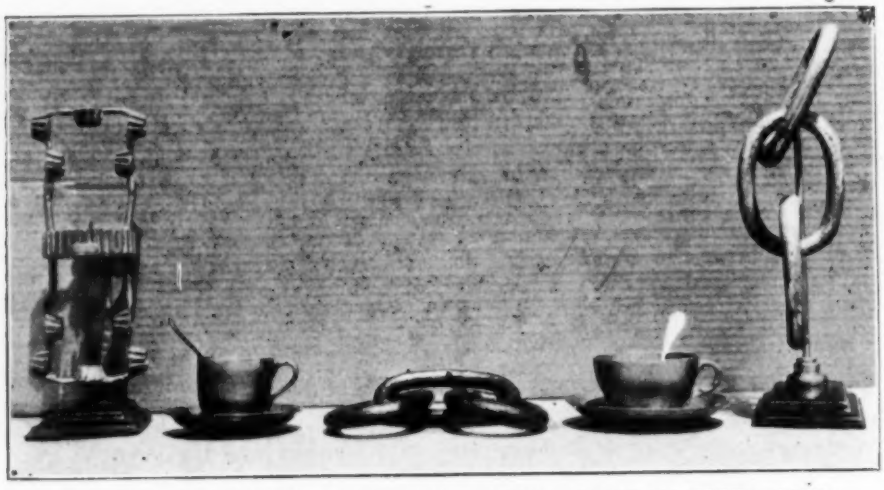
"Well," said Bill, "I'll tell you. I don't know if you can remember the order in which you asked these questions, but I am going to answer them in the same order with the single exception that I intend to take the last one first and then progress leisurely to the first one on the list as presented.

"This lad is not suffering from any hallucination. He served his time as a molder in the old National Malleable, Cleveland, but quit the trade to become a patternmaker before the job began to go sour or before he had a chance to exhaust all its possibilities. According to the theory of your modern psychoanalyst, suppressed desire has been gnawing at his vitals all these years and he now makes intricate castings in his spare time. The exer-

GOLF TERM: THE PLAYER ADDRESSES THE BALL

cise acts as a pop valve and sometimes the castings are invoked as object lessons to prove his familiarity with the practice and principles of the molding trade. Talk is all right up to a certain point, but the man who can produce the goods generally wins the argument.

"At his house he has rigged a discarded sink to serve in place of the traditional molder's *tub*. He makes all his own special little flasks, but up to the present he has not built a furnace to melt the metal. After the mold is made he takes it out to the shop of the Gluntz Brass Foundry Co., on east 55th street where Dan Gluntz obligingly throws a dash of metal into the mold from one of the pots. Dan is quite a lad himself in getting up



INTERESTING EXAMPLES OF TRICKY CASTINGS MADE IN GREEN SAND

rigging for intricate castings. I'll tell you about him some other time.

"A few typical castings are shown in the illustration. The cup-saucer-and-spoon is familar to nearly all foundrymen. Method for making the mold was described in the Jan. 1, 1925 issue of THE FOUNDRY. The collection of gears shown in the present illustration is decidedly out of the ordinary. The three links cast as a unit in green sand present a pretty little problem and also involve a fair degree of manual skill in their production. Finally to answer your first three questions in a word or two, the artist is a patternmaker with the Cleveland Lock Co., Cleveland, and his name is W. C. Lang.

"Examples like these do not appeal to men whose motto is "results, not methods." They only excite interest in the minds of men with the creative instinct, that is men who like to make things just for the pleasure of making them. I showed these complicated castings to a lad the other day and told him they were made in green sand. His only comment was that the green sand method was too slow. If he had the job he would make the casting in a set of cores, which, as he remarked any child could put together."

"It appears to me," I said, "that I read a story one time about chainmaking, but I don't remember now whether all the links were poured at the same time, or if a number of single links were cast first and then assembled between cores that contained the cavities of the connecting links."

"If you had the time and the patience and—let us say—the necessary intelligence to know where to search, you probably would discover that a hundred methods of chainmaking either have been or are at present in existence. In former times all chains were forged by hand. The blacksmith first made up half the number of links required to make a chain of a given length and then connected each successive pair by inserting an open link between them and then welding the opening. Some chains are still made in that manner, but the overwhelming majority are made on machines designed for the purpose. A length of rod or wire of any desired length or of any suitable metal is fed into the machine at one end and the finished chain emerges at the other end.

"At one time exceedingly heavy chains were carried on ships for anchoring and mooring the vessels. In recent years they have been supplanted to a great extent by heavy steel and fiber hawsers. The old time chains were all forged, but in modern practice heavy steel chains are cast in the foundry. A set of single links is cast first and later they are assembled between a row of dry sand cores with suitable cavities to form the connecting links."

"I know all about them," I said. "Kindly pass along. The line forms to the right. Also please omit all reference to watch chains, daisy chains, chain stitch, chain lightning, chain shot, chain lockers, chains and slavery, living chains, ball and chain, and chain the dog. I have no curiosity regarding these varieties. All of them probably occupy an important place in the general scheme of social and industrial life, but I am content to worry along without the slightest knowledge of how they are made or of who makes them. If you want to talk about the three links in the illustration I shall be pleased to lend an attentive ear although if I were left alone I probably could work out the puzzle for myself."

"Well," said Bill, "I'll tell you. Several methods are available for making the job, but to save you a severe attack of brain fag I'll tell you how it was made in this particular instance.

"The drag was filled with sand and the three links were bedded into the sand with the two end links in a horizontal and the central link in a vertical position. The sand was packed firmly all around them and then a parting was made flush with the joint line of the flask and along the center line of the horizontal links inside and outside.

"To simplify the explanation let me say here that four drawbacks were required around the central or vertical link. Two in the drag and two in the cope. Removal of these four drawbacks was necessary to free the central link from the sand.

"After the sand was packed firmly a semicircular opening was scooped on one side down to the natural parting line on the bottom of the vertical link. The sand was left on the other side and a straight vertical parting was slicked and covered with a piece of paper to serve as a backing against which to ram the sand for the first drawback. A piece of wire bent to shape for an arbor and provided with a hook for lifting was placed in the cavity and the space then was packed full of sand and slicked off on top flush with the main parting.

"Sand on the opposite side which served for a backing then was scooped out as far as the paper and a semicircular cavity similar to the first was formed. A second little arbor was placed in this opening and the sand was packed in and a parting formed as in the first instance.

"If you have been following closely you will note now in your mind's eye that the entire drag was rammed and a flat parting extended all over the face flush with the joint ilne of the drag. One half of the vertical link extended clear and unencumbered above the joint line and of course the upper halves of the two horizontal

links projected above the parting.

"It now became necessary to build the two upper drawbacks around the upper part of the vertical link before the cope was placed. Parting sand first was sprinkled on that part of the sand surface inside the horizontal links and under the vertical link. Then a mound of sand was packed around the vertical link.

"One-half might have been built up at a time, but it was more convenient to build the entire mound first, then cut away one half to make the vertical parting under the center of the link. This vertical parting was covered with paper and the second half of the mound was rebuilt. The mound on both sides then was slicked to shape with the parting line following the center line along the vertical link and following the natural parting line between and over those parts of the horizontal links that lay in that vicinity. Little wire arbors bent to the required shape and provided with suitable lifting hooks were placed inside the two half mounds of sand.

"The entire exposed surface of sand then was sprinkled with parting sand and the cope flask was placed in position on the drag. A gate pin was set upright a short distance inside the end of one of the horizontal links and the cope was rammed full of sand in the usual manner.

"Now we come to the interesting part, taking the mold apart to remove the pattern. The cope was lifted first and placed to one side. Then the first and second drawbacks were lifted in turn and also set down carefully out of the way. At this point the two horizontal links were free to be removed, but the two lower drawbacks still prevented the removal of the vertical link. Here is where a little trickery and a light and delicate touch were required.

"The two horizontal links were lifted from their sand bed and slid up until the lower ends met under the highest point under the vertical link. The three links were held in this position until first one and then the other lower drawback had been lifted out and placed tenderly on a mound of soft sand. With everything thus cleared away no difficulty was experienced in taking the entire pattern of three links out of the drag.

"After the two lower drawbacks had been replaced suitable gates were cut in the parting to convey the metal from one link to another. The two upper drawbacks were lowered into place, the cope was set on, the mold was clamped and taken to the foundry where the casting was poured."

"Your explanation is fair enough," I said, "Although I think you might have bolied it down a bit without affecting its clarity. However I should like to see the casting itself. Descriptions are all right so far as they go, but I could visualize the job better if I had the casting or the pattern in my hands and could run my eyes over it."

"The point," said Bill, "of my honorable friend is well taken. It proves two things. First like nearly all molders you feel on perfectly solid ground when planning with a pattern in front of you instead of a blue print or a description. Second it proves that my well meant description was not long enough, or to put it another way my delivery was a trifle too swift for your comprehension. You may as well admit it. The admission does not place you in a class by yourself. I have read occasionally of gifted individuals who could absorb a long written or spoken description, but I never have met one of these singularly gifted people.

"Speaking for myself I never could do it at one sitting. I might catch the high points, but in thinking it over afterward I usually find that my recollection is not clear on some of the minor details. In this particular instance a single description was sufficient because on many occasions I have had to handle jobs of a somewhat similar character and the routine is familiar.

"The collection of small gears had me guessing for a while and I had to ask the maker many questions before I finally understood how he had cast them all in one piece. I'll just give you a brief synopsis and then if the description is not clear I can go a little more into detail.

"To begin, the molder had one small gear and two pinion patterns. Also he had seven small special flasks. He made the main gear first in one large flask. Then he made four molds with two small pinions in each, one in the cope and one in the drag. Then he made two molds with a single pinion in each.

"In assembling the group of flasks he placed one with the single pinion on the bottom in a horizontal position. On this foundation he erected two flasks on edge containing the molds for two pinions each. He laid the flask containing the large gear mold on this pair. Then he set two other flasks on top of this, also on edge and placed the final flask with one pinion on top of the set. A long runner from the top conducted the metal to gates cut in the teeth of the large gear. Small runners through suitable openings in the joints of the vertical flasks conducted the metal from the large gear up and down to the small pinions in the flasks above and below the large gear and from them into the single pinion top and bottom. Now if there are any questions to ask, go ahead and ask them."

"Bill," I said, "I am afraid I am in the same position as the little boy in school. The teacher of the geography class said, 'Now who can tell me where Pittsburgh is?' After a judicious period of waiting one brave little lad at the back of the class piped up, 'If you please teacher Pittsburgh is playing in Chicago this week!' "

A CITY IS KNOWN BY THE TEAM IT KEEPS

Moore Engineering Co., Hagerstown, Md., manufacturer of gray iron castings and machined parts, has changed its name to the Dixie Machine Co.

John Fox & Co., New York, representatives of the Donaldson Iron Co., have moved their offices from the twentieth to the forty-first floor of the Woolworth building, 233 Broadway. Nicholas Engles is in charge.

How and Why in Brass Founding

By Charles Vickers

Gas Causes Porosity

We are sending for your inspection a casting of a small valve body which we have sawed in two to show a condition of porosity which lately has developed in our foundry. Can you advise us as to what the flaws in the casting are attributable, and if so what is the logical method of overcoming them. We melt nothing but the best of steam metal ingot in gas-fired, crucible furnaces and the analysis of the metal has shown no iron, phosphorus, aluminum or other material detrimental to the good of brass castings. The alloy consists of copper 85 per cent; tin 3.5 per cent; zinc 5.5 per cent, and lead 6.5 per cent. We do not use our own borings, and we sandblast all gates before melting them.

The metal is gassed. Thus can be seen by fracturing a sample and examining the fracture. The gas holes are mainly small and uniform, globular and bright, which indicates they are made by a reducing gas, not an oxidizing gas. It follows then they are made by a reducing gas, which means any gas with a tendency to take up oxygen. That only can mean there has been some little mistake in adjusting the valves for admission of air and gas to the furnace, and that too rich a mixture has been used.

This easily is remedied. Simply turn on more air, use an oxidizing flame instead of a reducing flame in melting. With an oil or gas-fired furnace it is possible to melt so rapidly that no time is given for the metal to take up oxygen, and under such conditions it is far better to melt without any attempt to cover the metal in the furnace. In fact such covers have been known to produce porosity, in such furnaces, under such conditions. The addition of any so-called deoxidizer such as phosphorus would have no effect in improving the solidity of the castings when the metal has been melted under a reducing flame, but when the metal has been slightly oxidized in melting, the addition of about 1 per cent of an alloy low in phosphorus will produce excellent results. While too much phosphorus is harmful, the proper amount is useful in preventing leaks and other troubles that might occur.

Metal that already has been gassed can be made sound by adding an oxidizing agent after it has been melted or by oxidizing it in the furnace, but as the latter procedure cannot be controlled accurately it is best to add an oxide, such as litharge. We are unable to state just how much to add and we would suggest 0.25 per cent to start as it will be necessary to experiment, and it may require one per cent. This must be added when the metal is hot, and a little time must be given for the gas to be eliminated. This method has been used with success, although it may make a difference whether the gas is hydrogen or carbon monoxide. The former would be converted to steam, the latter to carbon dioxide which is also soluble in the alloy, according to some investigotors.

Desires Aluminum Alloy

We are running a small aluminum foundry and want to know should any other metal be put into the aluminum to fit it for making such castings as kick plates, as we get little holes in the thin castings we make. We also want to learn what is used for polishing aluminum, what kind of a machine, and could we rig up anything cheap ourselves that would do the work?

If aluminum alloy ingot is bought there is nothing more to be added to it, but if virgin aluminum ingot is being used it will be necessary to melt 84 pounds of it with 16 pounds of an alloy that can be purchased, and which is known as aluminum hardener, fifty-fifty. This will make an alloy of 92 per cent aluminum with 8 per cent copper, and the best way to make it is to melt the hardener and the aluminum together. The small holes are accentuated by pouring the aluminum too hot, therefore, pour as cool as it will be possible to do and get perfect castings. By *perfect* castings we mean castings that completely fill the molds.

The subject of polishing aluminum is described in a very complete manner in the book, "The Metallurgy of Aluminum and Aluminum Alloys" by Robert J. Anderson. We do not believe that any rig can be cheaply fixed up that will polish aluminum or anything else in a decent manner. Cheap machines like cheap men produce cheap work, and cheap work never pays.

Make Matchplates Of An Aluminum Alloy

Please send us instructions on making match plates of aluminum and state what grade of aluminum to use. We also want to get a mixture for casting the white metal master patterns, and we want to learn how to mix copper, lead and zinc to make yellow metal.

In molding match plates to be cast in aluminum alloy, it is important to use a molding sand of an extremely open nature. The sand also must be fine, otherwise the castings will be rough and impossible to finish properly.

If the sand lacks the quality of openness the molten aluminum will not lie quietly in the mold, and the plate will be defective. A skillful molder is required to make good molds for such castings. The subject is an extensive one but it has been treated fully in past issues of THE FOUNDRY. An alloy that is quite suitable is copper 8 per cent; aluminum 92 per cent. New metal should be used. The above alloy is known as No. 12 aluminum and it may be purchased in ingots. However, the ingots should be of new metal and not rerun material for castings requiring careful work, such as match plates. A suitable mixture for casting white metal patterns is tin 50 per cent; zinc 50 per cent; as this is an alloy having little shrinkage.

To make brass, take copper 70.50 per cent; zinc 25.00 per cent; lead 2.50 per cent; tin 2.00 per cent; the copper should be melted first, putting charcoal on top of the metal. The metal should be melted until it looks blue.

Zinc then should be added in small pieces that have been well warmed, the mixture stirred and the lead and tin added. Pour while the metal is smoking strongly, skim back the dross carefully and pour strongly enough to keep the heads of the mold filled all the time it is taking metal. The mold must be well vented, to carry off the gases developed.

Melting Steel for Sand Molds

Requirements for Castings Differ from Ingots

By T. E. Hull

IN RECENT years there has been considerable advance in our knowledge of the behavior of metals during the cooling from the liquid to the solid state, and, as regards steel, the special problem of ingot solidification and cooling has received much attention.

The object of this article is to deal only with the subject of *liquid steel* as required for sand molds in the production of steel castings, and not to discuss the many and varied problems which have to be dealt with in the production of sound and homogeneous castings, for example, molding sands, facing sands, method of molding, risers, heat treatment, etc.

The basic principle in the production of liquid steel is the necessity of hot melting, prior to refining, with a view to controlling the balance of the slag components. This condition is assisted by the judicious use of limestone.

High temperature refinement is beneficial in producing a steel in which the slag inclusions are more easily removed owing to the physical condition of the bath—also, high temperature control at the refining stage produces a more siliceous or balanced slag, with the minimum of FeO in solution in the finished steel. The higher the temperature of refinement, the greater the density of the resultant steel, a factor of importance in the case of steel required for high pressure castings. Generally speaking, especially for light and intricate work, steel should be poured at as low a temperature as possible consistent with fluidity. This principle controls the following phases through which the steel must pass from the liquid to the solid state: (1) Liberation of larger volume of dissolved gases, held in solution, thereby reducing shrinkage effect and indirectly lowering the total shrinkage of the mass for the coefficient of expansion or contracting rises with the temperature. (2) Approaching nearer the ideal condition by bringing the liquid steel nearer to its congealing point and incidentally allowing minimum of erosive action on the sand runner and mold. (3) The time period through which the steel, as cast remains in its critical state of weakness when at its congealing temperature or weakest period.

The *fluidity* of converter steel is largely governed by the quantity of dissolved and occluded gases. This fact is substantiated by the action of gases on molten metals in general and is in a much less degree a matter of temperature. Chemical composition of the steel in a less degree governs this factor of fluidity.

It is a well known fact that the lower the carbon in the bath, the more oxygen is liable to be dissolved in the metal, as the carbon has less influence in removing it, as a result there is more loss on manganese and silicon additions. For steel castings it is recommended that the finished carbon be as high as possible consistent with giving, on mechanical test results such as are called for by specification and with the best machining properties. It is also to be recommended for steel for intricate and pressure test castings that the manganese content should range about 0.8 per cent.

Metal Must Be Superheated

After selection of materials for the charge, the first point to be observed in the production of liquid steel of dependable quality is the necessity of hot melting down. Too much stress cannot be laid upon the necessity of super-heating the bath of molten metal, prior to the refining process. Quick and hot melting at this stage reduces the basicity of the slag formed by oxidation, during the melting period. The proportion of silica to basic oxides composing the slag, being a function of the temperature. When the charge is melted clear, the addition of iron ore, or as in the case of the converter, the application of the air blast should never be commenced until the melter is certain that the bath is sufficiently hot. Experience often points that too little attention is paid by some steel makers to the melting temperature, which primarily governs the slag condition of a charge, their object being to make steel and not slag, the composition of the latter being of little interest. They overlook the fact that the quality of the steel is dependent upon the state of the slag. It is almost an axiom in practice that if the slag be right, the metal will be right. Limestone additions have a valuable effect upon both steel and slag when added judiciously. These additions tend to obtain perfect equilibrium in the furnace bath by lowering the iron contents of the slag, which can only occur when the metal has become thoroughly deoxidized. This condition is essential before the addition of the finishing alloys, if the subsequent production of steel of the highest quality is desired. In other words, limestone is added to the slag during the working of a charge with the object of steadily decreasing the concentration of FeO in the slag, so that by the end of the process the slag will contain a very low percentage of FeO.

Every mass of steel contains inclusions to a greater or less degree as it is impossible to manufacture steel without them. Much defective steel is bad solely because of the amount of non-metallic particles which it contains and a large number of failures due to faulty material have been traceable to this cause. All the evidence is favorable to the view that FeO is in solution in liquid steel and it follows that the addition of an element having a stronger affinity for oxygen than iron will reduce both the amount of FeO and the amount of gases in solution.

In the class of inclusions formed by an admixture, which embraces slag and fluxed material, and also with MnS inclusions, a high temperature refinement is beneficial for reasons which are purely physical, such as the increased fluidity of the liquid steel enabling the inclusions to be freed and not entrapped. The influence does not stop here, for the slag is in equilibrium with the constituents in the steel and by the partial law of temperatures the concentration of the FeO in the slag bars a relation to its concentration in the resultant steel. When unduly impregnated with slag inclusions, the steel is correspondingly weak and is susceptible to cracking or pulling during solidification in the molds. Too much emphasis cannot be laid upon the necessity of superheating prior to refining. A high temperature of working implies not only less

From a paper presented at a meeting of the West Yorkshire Metallurgical society of England. The author T. E. Hull is a past president of the society.

FeO in the steel but also a more siliceous or balanced slag. Every steel maker will agree that this deduction from theory is in accordance with regular practice.

All molten metals possess the power of absorbing or dissolving quantities of various gases, and that molten steel, regardless of how carefully it is melted, contains a considerable volume of gases in suspension.

It is commonly seen and well-known to all practical foundrymen that pouring and feeding of a steel casting is accompanied by a vigorous gas escape through the feeding heads of the casting—so-called shrinkage cavities are thereby being filled with molten metal, the gaseous contents of the cavity being ejected through the head. There is no doubt that dissolved or occluded gases have an important bearing on the shrinkage of steel at the time of its freezing and cooling in sand molds, and steel which has been highly superheated above its melting point shows a higher co-efficient of contraction than similar steel melted with little superheating. The necessity for cooling down in the furnace or ladle before casting such superheated steel, is well known as an antidote to excessive shrinkage or piping troubles.

It is safe to assert, that steel produced by any of the converter methods is always liable to eject larger volumes of dissolved or occluded gas than a steel produced by the open hearth or electric furnace. In view of the effect of dissolved gases upon liquid metals in general, the term lively, as applied to convertor steel, can be more easily understood. Solidified steel, free from blow holes, however, does not necessarily mean steel free from gases.

Shrinkage And Contraction

It is unfortunate that considerable confusion exists regarding the definition of the term shrinkage. Shrinkage and contraction are synonymous terms, although an effort has been made to confine the former term by applying it to liquid contraction and restricting the term contraction to the volume change in the metal cooling from the freezing point. Steel shrinks in volume with fall in temperature in three distinct states: In the liquid state, in the liquid and solid state, and in the solid state.

The shrinkage effect in the first two states will be uniform in rate and direction while in the solid state the conditions are variable. The metal is undergoing a change of density with the change of state, which makes it clear that the higher the temperature at which the metal enters the mold, the greater the liquid shrinkage from its temperature at entrance, to its temperature at the freezing point. It is not an uncommon experience for castings to show little or no trace of piping in the feed heads, when by accident, through nozzle stoppage, the steel has become almost frozen in the ladle, but just retaining enough life to fill the mold—such a condition shows clearly the effect of temperature upon shrinkage.

At temperatures bordering on 1150 degree Cent. steel is weak in the intercrystalline sense, which can be demonstrated when attempting to extrude or draw it at that temperature. Any condition which tends to keep the casting in contact with the molds continuously and which assists rapid freezing, especially in the portions which are liable to fracture through irregular contraction, would be to advantage.

Liquidity And Fluidity

A general statement has frequently been made that converter steel is more fluid than that produced by either the electric or open-hearth furnace, although hazy suggestions as to this phenomena have been advanced. It is the writer's opinion that converted steel possesses longer life in the ladle than steel produced by any of the other methods. Too much stress has been placed on pouring temperature in considering this relationship while the importance of the term liquidity as applied to steel provides an avenue of research still to be explored. Suggestions have been advanced with a view to explaining the fluidity of converter steel as follows:

By the presence of dissolved oxides. By incomplete reactions between finishing alloys in ladle. Through high temperature conditions.

It has been determined from practical experience that no matter how hot the steel may be originally, if it is full of oxides it will chill rapidly in pouring. On the other hand, steel free from oxide inclusions will run when cold and seems to pour better.

In the author's own experience liquid steel is being poured daily from a stock converter plant with the minimum slag inclusions and when compared with high quality electric steel, with final reactions fully completed before entering the ladle giving a perfectly dead melt. The converter steel, although produced under superheat melt and refining conditions, is cast at only a moderate temperature, having been cooled before tapping, and on casting into molds is perfectly fluid and solidifies well.

The real difficulty confronting the investigator on the lines above suggested is that of obtaining comparisons on the three methods of production of liquid steel of even chemical composition and temperature control, together with a really reliable method of estimating oxide inclusions and dissolved gases.

In the mentime this important matter stops at assumption based on phenomena.

Note Composition

It is fairly safe to say that with reference to steel for castings, a sulphur content under 0.08 per cent is not the *bogey* it has been considered to be in times past. The beneficial effect of manganese on steel has long been known and the connection between the presence of sulphur and the neutralizing effect of manganese is now fully appreciated.

Arnold was the first to show how the dangerous iron sulphide inclusion in steel was replaced by dove-colored globules when sufficient manganese was present. It is now generally accepted fact that the dove-colored areas were composed of manganese sulphide and that the location of iron sulphide between the grains, accounting for the red-shortness of steel containing little or no manganese. Theoretically, one part of sulphur in steel requires 1.73 parts of manganese to form MnS but in practice more has been found necessary and desirable. Stead states that up to 0.060 per cent sulphur it is safer to have at least eight times the manganese content over the sulphur content and this figure is at the present time generally adopted in works practice.

In view of the researches of Hackeney, Arnold, Brinell, Thompson and Stead, it has been shown that as the percentage of sulphur decreases, the ratio of manganese to sulphur must be increased if the evil effect of the sulphur is to be effectively removed. As a general contention the manganese content of steel required for castings to give favorable results will vary between 0.8 and 0.9 per cent, thus assisting to give further fluidity to the steel, while mitigating to a very large extent against shrinkage cracks or pulls.

The silicon content of steel for general castings should be held between the limits of 0.25 to 0.35 per cent.

The imposition of specifications, of an unsuitable character, often compels the manufacturer to meet imposed tests rather than common-sensed ones.

Most melters will agree that the lower the carbon the more difficult the steel is to handle. The lower

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

CARE AND MAINTENANCE OF WIRE ROPE

HOW TO MEASURE WIRE ROPE

There is only one correct way to measure wire rope and that is shown in contrast to the incorrect method by the accompanying illustration.

It is highly important that the proper size of rope be employed since an undersized rope will not give the degree of service that reasonably should be expected, while an over-sized rope represents needless investment. More important, however, is to

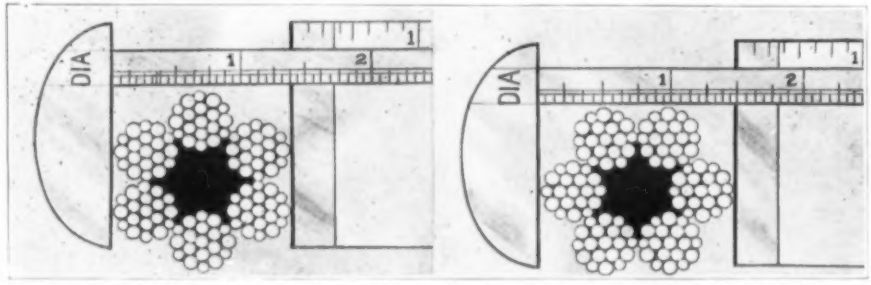


FIG. 1—INCORRECT AND CORRECT METHODS OF MEASURING WIRE ROPE

have the rope and the sheave properly fitted. No wire rope should be allowed to travel over a sheave wherein the groove is too small for the diameter of the rope. A pinching groove will do more damage to a wire rope in one hour than a properly sized groove in a week or more. Sheaves grooved 1/16th of an inch larger than the diameter of the rope will lengthen the life of the rope many times as compared with rope life on pinching sheaves. Since sheaves are cheaper than good wire rope, there is small economy in continuing the operation of improperly grooved sheaves or drums.

Tread diameter of drums or sheaves also greatly affects wire rope life. Wherever possible, large diameter sheaves should be used, for the bending stresses thereby are reduced. Reverse bends also should be eliminated where possible since such reverse bending greatly diminishes rope service.

This series of data sheets and the photographs on caring for and maintaining wire ropes were supplied through the courtesy of the American Cable Co., New York.

CARE AND MAINTENANCE OF WIRE ROPE

LUBRICATION OF WIRE ROPE

Practically all the cores of good brands of wire rope are impregnated thoroughly with a commercial, chemically-neutral rope oil. While the core retains a liberal supply of this lubricant which gradually oozes out as the rope is used, still, frequent application of a good lubricant during service is necessary to prevent the core from becoming dry. A dry core will both wear and crush quicker than an oil-impregnated core. Furthermore it will absorb moisture with the result that the core will deteriorate rapidly and the inner wires will corrode with shortened rope service as the result.

The smaller the sheaves or the heavier the tension on the rope, the more often should the rope be lubricated. A good lubricant retards corrosion of the wires and deterioration of the core, reduces internal friction which is the cause of wires breaking from bending stresses, and decreases external wear. Lubricant should be thin enough to penetrate the strands and the core but not so thin as to run off the rope nor so thick that it merely covers the rope.

Therefore, a thicker, semiplastic compound applied *hot* and in a thinned condition, is the best wherever possible. It will penetrate while hot, then cool to a plastic filler, excluding the entrance of water, both preserving and lubricating the inner wires and cores.

To lubricate properly with a heated lubricant, it is necessary to have the rope run slowly through a tank of heated oil. This is the best possible method to allow penetration. Where this is not possible, an application of a thinner and unheated lubricant will give better practical results.

It is always well to lubricate the rope just after installation and before running in service, particularly when such ropes have been kept in storage for any length of time.

Around the World with The Foundry

Little Journeys to the homes of our readers

Wales

DEFYING them all in turn: Phoenicians in search of tin and copper; Romans in their triumphal western march; Angles, Danes, Teutons; Normans in the train of William the Conqueror and finally, the English kings themselves, the little principality maintained a separate existence for over 1400 years before it was merged into and absorbed as a part of monarchial England. Even today, the ancient Celtic language is spoken in the hills and valleys of Wales.

Laden deep at the great docks of Swansea and Cardiff, in fair weather and foul, slipping peacefully down on fine summer days; cautiously feeling their way in the fog and drizzling rain of the spring, or fall; or, beating their way through the racing seas in the face of south-westerly winter gales, the big cargo boats plow down through Bristol channel and head away to all the ports on the seven seas where British coal and British steel rails furnish the motive power for industry and the means of transportation for modern commerce.

The casting industry has kept pace with the other branches of engineering responsible for the vast development of the coal mines, blast furnaces, rolling mills and allied enterprises. It is an eloquent tribute to the intrinsic worth of THE FOUNDRY that master foundrymen in this conservative district should welcome this foreign paper twice a month and then circulate it among their heads of departments and leading workmen as a source of current information not found in any text book.

"Wherever metals are cast you'll find THE FOUNDRY"

the carbon the higher the temperature at which the steel must be cast.

Satisfactory castings can be produced with a 0.2 per cent carbon steel, but better and sounder castings of the intricate and light section type can be more easily obtained with a steel which gives a 0.5 per cent carbon content. This is more particularly true of castings designed to withstand high steam pressure.

With reference to the use of deoxidizers they will not make bad steel good. The judicious use of aluminum in the ladle may be useful and beneficial to a steel which has been properly killed in the furnace. Deoxidizing should be commenced in the furnace or converter and completed in the ladle before the steel ever reaches the mold. Most metallurgists will agree that liquid steel badly produced will reflect itself in the casting.

Melt Steel Heats in a Cupola

(*Concluded from Page* 780)

produced in the foregoing manner from an all steel charge. For our purpose we needed a metal to resist abrasion, to wear down uniformly without cracking or spalling. Our product is low in silicon and manganese and has a brinell hardness of 600 to 712. We had no need for a synthetic or machinable gray iron, therefore no effort was made to secure an iron of that character.

Synthetic cast iron has been made from steel charges in electric furnaces and in small experimental cupolas at various universities, but definite information seems to be lacking in the detail of operation. Results, particularly in recarburization, have not been positive. Introduction of silica into the charge will increase the silicon content, but at a corresponding reduction in the amount of carbon. The most satisfactory method of raising the carbon content appears to be through the addition of ferrochrome.

Pipe Coils Leak in Iron Furnace Bottoms

Question: We have experienced considerable trouble in attempting to make the furnace bottom plate with a coil made up of several long loops inside. The pipe is 1¼-inch extra heavy with the ends connected by malleable iron tees. The outlets are stopped with standard plugs. It is claimed the openings in the ends are required for future cleaning of the pipes. The pipe joints are coated with graphite grease before the connections are screwed firmly into place. The casting is made in a dry sand mold and gated at one side about 10 inches from each end. The casting is poured from a half and half pig iron and scrap mixture which yields a 1.80 per cent silicon content in the casting. The metal is poured hot and a stream of water is kept flowing through the coils while the mold is filling. We have made a number of these castings, but when we test them under 35 pounds per square inch water pressure, they invariably leak. We are of the opinion that the trouble is due to the expansion of the iron and the sealing compound in the joints burning.

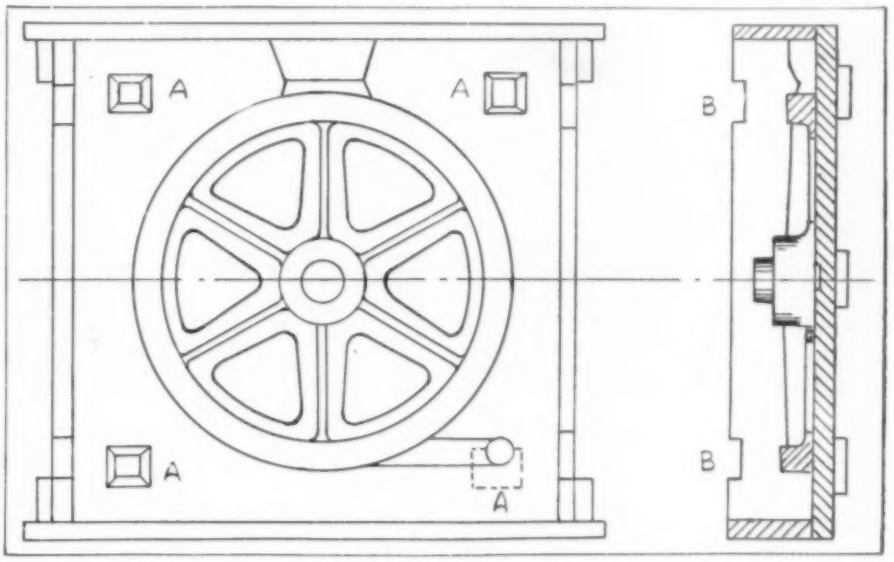
Answer: We know of only one way in which a water tight coil may be secured in a casting and that is to form the coil from one continuous length of pipe. Two or even three ordinary sections of pipe may be joined either by welding or by the ordinary union to form this continuous length. The only limiting factor in this arrangement is that the joints must come at a point as far as possible removed from the ends of the casting. In the event that openings *must* be provided in the ends of the coil we fear you will have to change the design of the casting so that the pipe connections may appear outside the ends. We have seen many castings in which cooling coils have been incorporated, but we never have seen one in which the coils had to be cleaned. Invariably the casting has been scrapped from some other cause before that time arrived.

Your conjecture that the law of expansion and contraction is responsible for the leaky condition of the pipes is correct. In addition to the tremendous strain set up in the approximately 60 feet of pipe forming the coil, during the time it is heating while the mold is filling with iron, another strain is set up while the metal is cooling on account of the difference in contraction between wrought iron, malleable and gray iron.

Gear Blanks Are Cast in Cores On Edge

By William Pink

The method shown in the accompanying illustration was adopted to insure solid metal in steel gear blanks that almost invariably showed holes around the rim when cast flat in the usual manner. These steel wheels apparently were solid leaving the cleaning room but the cavities showed up when the teeth were cut. A half pattern was located on the bottom of a square core box and a number of half cores were made which corresponded to the usual copes and drags. Suitable dowels were provided in the bottom of the corebox to form corresponding depressions and projections for matching the half cores after they were dried. One dowel was changed alternately from right to left to accommodate the runner. Two channels were formed across the back of each half core to hold a pair of flat straps. After the cores were dried they were assembled in groups of four or six arranged to be poured from a single runner. Long bolts extending through suitable holes near the ends of the straps were used to bind the cores closely together.



THE LOWER DOWEL *A* WAS REVERSED FROM SIDE TO SIDE TO ACCOMMODATE THE RUNNER. FLAT BARS WERE LAID IN THE COREBOX AT *B* TO FORM GAPS FOR THE BINDING STRAPS

OHIO FOUNDRYMEN Broaden Association Scope

PRELIMINARY plans were made at the sixth annual convention of the Ohio State Foundrymen's association held in Cincinnati Sept. 16 and 17, to widen the scope of activity of that organization. The board of administration extended a formal invitation to members of the Indiana Foundrymen's association to affiliate and become active in the affairs of the former organization.

The Indiana association which was active several years ago never has been disbanded, but has not functioned for the past year. W. D. Hammerstadt, Rockwood Mfg. Co., Indianapolis, a past president of the Indiana association, was present at the Cincinnati convention and was advised of an arrangement whereby Indiana members may join the Ohio group and may be assured of representation in the executive offices. A. I. Rumely, Laporte Foundry & Furnace Co., La Porte, Ind., who was secretary of the Indiana association, will be associated in the work of enlarging the scope of the Ohio body.

The Cincinnati convention proved to be one of the most successful ever held by the Ohio State Foundrymen's association. A record attendance of nearly 200 including about 40 ladies marked this convention as the outstanding convention held so far.

The opening technical session was held at the Hotel Sinton Thursday afternoon following an informal luncheon. An address of welcome was delivered by Mayor Murray Seasongood with response by Vice President C. C. Smith, Toledo Steel Castings Co., Toledo.

At the first technical session held Thursday afternoon, Sept. 16, Herman Schneider, dean, college of engineering and commerce, University of Cincinnati, gave an interesting discussion of the modern trends in research. He outlined progress which has been made in the study of molecular and atomic structure and the electro-magnetic wave theory of matter. Discounting the popular conception that this abstract science can have no direct practical benefit, he called attention to the expenditure of over $400,000,000 last year on radio equipment. All of this was a direct outgrowth of the discovery of the wave transference of energy. Dean Schneider told of co-operative research work being carried on by different groups and prophesied that within a few years the application of pure mathematical and scientific principles may lead to marked changes in metallurgy and in heat treatment of industrial metals used.

Brass foundry problems and their solution were discussed in an interesting manner by Fred Wolf, superintendent, The Ohio Brass Co., Mansfield, O. Mr. Wolf believes that foundry losses constitute a true index to efficiency and that a loss record properly classified places responsibility. His company keeps such records and gives them marked publicity throughout the organization. Instructors are employed in the different departments to watch these defectives and a wage and bonus plan serves as an incentive to reduce spoiled work. A committee passes upon all questions of gating and pattern construction. Raw materials are purchased on specification. Close control is maintained over the sand employed. One result shown by Mr. Wolf is that while sand costs in 1922 were a dollar per ton of good castings, this figure has been reduced to 18 cents in the past year. The expense of investigating and treating the sand is more than compensated by the effect upon the quality of product through uniformity and by the psychological effect upon the men.

E. J. Lowry, Hickman, Williams & Co., Chicago, delivered a paper on cupola practice. He outlined the fun-

WALTER L. SEELBACH
Re-elected President of the Ohio State Foundrymen's association

ARTHUR J. TUSCANY
Again Chosen for the Executive Office of Secretary-Manager

C. C. SMITH
Selected for a Second Term as Vice President of the Ohio Group

damental principles underlying correct charging and delivery of air for melting. His comments on the variables encountered covered the factor of widely different sized scrap and the effect upon final analysis of the metal. The physical condition of the pig iron, the weight of the pigs and other factors not commonly taken into consideration exert a marked influence upon the loss in silicon, manganese and carbon and the pick-up of sulphur, according to Mr. Lowry.

The Ohio State association since its formation has taken an active interest in foundry cost accounting. This fact was emphasized by the attendance interest shown during the presentation of the last address on the Thursday program. A. E. Grover, Berea, O., in his authoritative discussion of this subject defined costs as a measurement of investment and application of this investment to individual products. He showed a series of forms ranging from a stores record through the various tabulations required by different departments to a complete summary of costs. His distribution of building overhead is made on a basis of floor area to the different departments. The cost of supervision sometimes regarded as managerial overhead is distributed on a basis of man-hours of labor directly to the various departments. A daily melting cost form is supplied which ties in with the store's records.

An interesting feature of Mr. Grover's system is the use of operation time cards as a measure upon which to base the computation of wage payment.

In speaking of the dual purpose of costs, namely to serve as a basis for establishing a price and to afford a check upon departmental or general efficiency and economy, Mr. Grover suggested the accumulation of similar data in a number of foundries through an impartial agency. This data, it was suggested, might be summarized, an average drawn and the lowest cost and average figure be made available to each foundry participating in this interchange of information.

An informal banquet was held Thursday evening at which entertainment was provided by the local Cincinnati committee, a list of which is shown accompanying. Exceptional entertainment features were provided throughout the two days of the session. Ladies' sightseeing trips, luncheons and a dinner at Castle Farm constituted high points in the entertainment program.

The second day of the convention was devoted to plant visitation in the morning, to a round table luncheon at noon and a technical session in the afternoon. The round table discussion was divided into three groups. The authors of papers of the preceding day's sessions presided. These were as follows: Brass Foundry Problems, Fred Wolf, chairman; Cupola Melting, E. J. Lowry, chairman; and Foundry Costs, A. E. Grover, chairman.

Interest in the broader aspects of industry was shown by the consideration given at the meeting Friday to an address by J. M. Fitzgerald, former president of the Western Maryland Railway Co. on the subject

Arranged Extensive Entertainment

General Chairman, R. J. REDMOND
The Buckeye Foundry Co.

RECEPTION COMMITTEE

HARLEY A. NASH, *Chairman*
The Ohio Pattern Works and Foundry Co.

EDWIN B. HAUSFELD
The Ohio Pattern Works and Foundry Co.

EARL KNIGHT
The Allis-Chalmers Mfg. Co.

A. W. WILLIAMSON
The Williamson Foundry Co.

W. J. FEY
The Peerless Foundry Co.

L. A. GOSIGER
The S. Obermayer Co.

A. G. WESSLING
The Wessling Bros. Foundry Co.

GEORGE W. PIEHL
The Wessling Bros. Foundry Co.

G. EUSKIRCHEN
The Cincinnati Foundry Co.

J. B. SCHUMACHER
The Cincinnati Foundry Co.

R. L. PERKINS
The U. S. Cast Iron Pipe & Foundry Co.

ELLIS DECAMP
The Williamson Foundry Co.

L. G. SCHRIEBER
The L. Schrieber & Sons Co.

CHRIS ERHART
The Chris Erhart Co.

W. A. HOFFENJANS
The Star Foundry Co.

GEORGE D. BEHLEN
The U. S. Electrical Tool Co.

GEORGE KLAINE
The Star Foundry Co.

BENJAMIN I. KAUFMANN
The Edna Brass Mfg. Co.

ELDON L. CUNNINGHAM
Central Brass and Aluminum Foundry Co.

FINANCE COMMITTEE

J. D. LEARY, *Chairman*
The Queen City Foundry Co.

JOHN HILL
The Hill & Griffith Co.

SAMUEL M. BLACKBURN
The Jno. B. Morris Foundry Co.

TRANSPORTATION COMMITTEE

HAROLD P. RITTER, *Chairman*
The J. A. Oberhelman Foundry Co.

L. B. WEBER
The Elmwood Castings Co.

PHILIP CONE
The Modern Foundry Co.

F. A. KLAINE, The Star Foundry Co.

LADIES COMMITTEE

HARRY FELDBUSH, *Chairman*
The Worthington Pump & Machinery Corp.

CHAS. T. CRAWFORD
The Reliance Foundry Co.

LEROY BROOKS, JR.
The Sawbrook Steel Castings Co.

SIDNEY J. NEWMAN
The Newman Mfg. Co.

JOHN T. ROTHER
The Walter Wallingford Co.

SPEAKERS COMMITTEE

GEORGE F. DANA, *Chairman*
The Peerless Foundry Co.

WALTER H. GEIER
The Modern Foundry Co.

PLANT VISITATION COMMITTEE

DAVID C. JONES, *Chairman*
The Lunkenheimer Co.

GEORGE A. SEYLER
The Lunkenheimer Co.

SOUVENIR COMMITTEE

ARTHUR OBERHELMAN, *Chairman*
The J. A. Oberhelman Foundry Co.

H. J. WEBER
The Wessling Bros. Foundry Co.

WILLIAM GILBERT, JR.
The Buckeye Foundry Co.

BANQUET COMMITTEE

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The J. B. Morris Foundry Co.

DAVID C. JONES
The Lunkenheimer Co.

GEORGE F. DANA
The Peerless Foundry Co.

A. W. WILLIAMSON
The Williamson Foundry Co.

JOHN OBERHELMAN
The J. A. Oberhelman Foundry Co.

GEORGE MCG. MORRIS
The J. B. Morris Foundry Co.

CHESTER A. PEEBLES
The Stedman Foundry & Machine Works

F. W. MILLER
Rogers, Brown & Crocker Bros. Inc.

WALTER H. GEIER
The Modern Foundry Co.

W. L. PERKINS
The U. S. Cast Iron Pipe & Foundry Co.

ENTERTAINMENT COMMITTEE

E. A. LEARY, *Chairman*
The Cincinnati Steel Castings Co.

V. E. MONTGOMERY
The V. E. Montgomery Co.

CHARLES BROWN
The Lunkenheimer Co.

HOTELS AND RESERVATIONS COMMITTEE

ROBERT CADEE, *Chairman*
The Chris Erhart Co.

HARRY A. KLAINE
The F. A. Klaine Co.

of the public attitude toward the common carriers. An illustration of the vital character of railway prosperity was shown by the speaker when he mentioned that one family out of every six is dependent upon some class of railroad employment for its sustenance.

George A. Richardson, technical publicity department, Bethlehem Steel Co., Bethlehem, Pa., brought to the assembled foundrymen, at the same session, a conception of the manufacture of pig iron. Four reels of motion pictures gave a clear understanding of the mining of ore and coal, the manufacture of coke and finally the process of making pig iron, emphasizing the care employed to secure a uniform product for the foundry demand.

In the report of the secretary-manager, A. J. Tuscany, Cleveland, presented Friday afternoon the organization of local cost groups was suggested, and the approval of the scrap contract form suggested by the department of commerce was announced. Mr. Tuscany again urged the establishment of some form of joint research tending particularly to standardize high quality gray iron, and to offer to members laboratory facilities for the study of both iron and brass metallurgical problems.

The Ohio state group is operated under direction of a board of administration consisting of fifteen members, five of whom completed their terms at this time. The new directors chosen were as follows: G. H. Alten, Alten's Foundry & Machine Works, Lancaster, O.; H. Loudenslager, Loudenslager Foundry Co., Columbus; A. H. Kramer, Advance Foundry Co., Dayton; Charles T. Crawford, Reliance Foundry Co., Cincinnati; J. H. Bruce, Bowler Foundry Co., Cleveland.

The executive officers all were reelected. These include Walter L. Seelbach, Walworth Run Foundry Co., Cleveland, president; C. C. Smith, Toledo Steel Casting Co., Toledo, vice president; Arthur J. Tuscany, Cleveland, secretary-manager; and E. Sands, Superior Gas Engine Co., Co., Springfield, O., treasurer.

Estimate Casting Weight from the Pattern

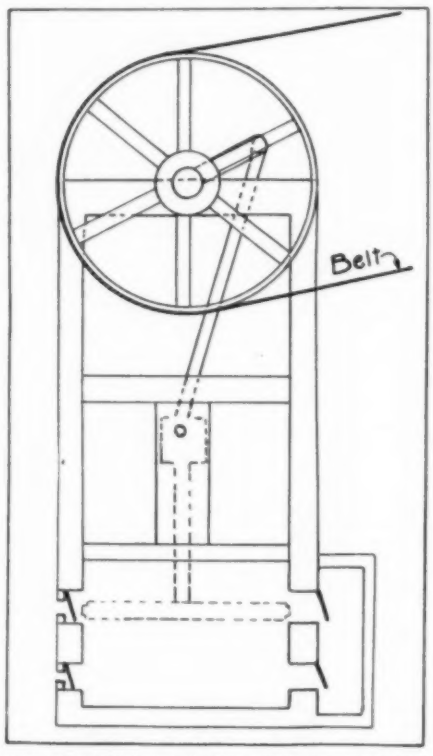
Question: Our contention is that a casting made from regular No. 12 aluminum alloy will weigh seven times the weight of a pine pattern. One of our customers claims that the correct ratio is 1 to 5.

Answer: In all the published tables dealing with this subject the weight of an aluminum casting is given as five times that of a pattern made from white pine. One pound of a yellow pine pattern will result in 4½ pounds in aluminum and a casting from a red pine pattern will weigh 3¾ pounds to each pound of pattern. However, this weight is based on the specific gravity and rarely is possible to obtain under actual working conditions. Nearly all castings made in green sand molds strain to a greater or less extent and this particularly is true with large castings, where a variation in weight between the anticipated and the actual result, would be most noticeable. Patterns sometimes deliberately are made thinner than the proposed casting to anticipate this tendency to strain in the mold. Obviously in a case of that kind the actual weight of the pattern would not bear a true relationship to the weight of the casting. Technically your customer is correct in his claim of 5 to 1.

Uses Old Piston Bellows

Probably the only piston blower in America used for supplying blast for a cupola still is doing duty after more than 50 years continuous service in the Ward Devereaux foundry, Bancroft, Mich.

My father Calvin Devereaux came to Shiawassee county, Mich., from New York state and settled first in a small town named Newberg where he erected and operated a small foundry. Later the tracks of the Chicago & Port Huron railroads, now part of the Grand Trunk system, were laid 2 miles beyond the town and the town just died a natural death. My father moved his foundry to a little settlement that later came to be known as Bancroft. I have not worked in the foundry for many years, but my elder brother Ward Devereaux carried on after my father died and he still operates the foundry.



AIR IS DRAWN IN ON THE UP STROKE OF THE PISTON AND DISCHARGED UNDER PRESSURE ON THE OPPOSITE SIDE OF THE AIR CHAMBER ON THE DOWN STROKE

Originally a small fan was used on the cupola, but it was too noisy. Every person in the village knew when a heat was being run off in the foundry. Finally my father bought the shafting and piston rods for a piston blower, but they lay unused for several years for lack of a man with sufficient knowledge to build the machine. Eventually an old millwright named Norton appeared on the scene and he set up the blower. The fact that it has been operating continuously since that time is eloquent tribute to the skill and knowledge of this honest old artisan.

With the exception of the wrought iron crankshaft, piston rods and crossheads, the entire piece of apparatus was made of wood. The frame and connecting rods were made of maple and the air chambers were enclosed in white pine. Even the crankshaft ran in maple journals and the crossheads traveled in maple guides. A fair general idea of the contrivance may be had from the accompanying illustration taken from a rough freehand sketch.

A single pulley drove the crankshaft mounted on top of the frame. Three cranks on the shaft 60 degrees apart were connected to three wood pistons about 2 feet square enclosed in three separate chambers. Candle wick was used for packing at the point where each piston rod entered the chamber and leather strips around the edge of the piston rendered it tight. Each of the air chambers was connected to a common auxilliary air chamber from which the air entered a pipe that led to the cupola. Top hung leather valves 3 x 6 inches admitted air to each chamber while the piston was on the up stroke. The down stroke of the piston automatically closed these valves and opened others on the opposite side which allowed the air to enter the auxilliary chamber under pressure. With the three cranks working in regular sequence after each other the pressure in the auxilliary chamber was kept fairly constant.

GRANT DEVEREAUX, Battlecreek, Mich.

German Foundrymen Convene in Berlin

Activities of the Association Described—Papers on Research and Other Important Foundry Topics Are Read in Technical Session

THIS year's general meeting of the Verein Deutscher Eisengiessereien, or German Foundrymen's association, Dusseldorf, was held Aug. 25-27 at the Institute of German Engineers, Berlin, under the chairmanship of Dr. Werner, the association's president. Representatives from all sections of the country attended for the purpose of devising measures for overcoming the difficulties of the present economic situation. The first two days were devoted to committee meetings and meetings of other special sections of the association. A number of technical papers on research and other work of special importance to foundries also were presented.

Herr Erbreich, director of the Tagerheutte Iron and Enameling Works, read a paper on "The Present Position of Drying Stoves for Molds in Iron and Steel Foundry Practice." Dr. Kuhnel of the State Railway central office reported on "The Results of Tests on Fire Bars." Dr. Lischka, Dusseldorf, gave an address on "The Determination of Piece-work by Means of Time and Work Studies."

A reception was held on the evening of Aug. 26 at the Deutsche Gesellschaft. The general meeting was held on Aug. 27, a large number of guests being present. In his address of welcome the president expressed pleasure that notwithstanding the economic difficulties of the time the meeting was so well attended. He then gave a report on the past business year that has been marked by a severe economic crisis which influenced the membership roll which now numbers 1339.

Activities of the association cover the procuring of the best possible supply of raw materials, and the regulation of prices and conditions of supply for foundries by keeping in constant touch with the supplying and consuming associations. Greatest attention has been devoted to the cutting down of production costs as well as to the equipment and improvement of works on the most systematic and scientific lines, in which connection the Foundry Advisory Co., established by the association last year, has rendered valuable and growing service.

By supporting technical colleges and institutes, as well as by helping needy students of foundry work, the association is endeavoring to advance the industry and to promote the specially important work of insuring that the rising generation shall be competent. Technical work of the association included the organization of the Dusseldorf foundry exhibition which excited favorable opinions both in Germany and abroad. A film of the most important exhibits was shown, thereby bringing them within the reach of those who were unable to be present. Subjects of a technical nature to which attention long has been devoted are the design of castings, the researches on which now have resulted in definite conclusions, and also the drying of molds and the utilization of waste material. New subjects of study taken up were investigations in connection with recent cleaning devices for castings, the causes of different properties in pig iron and cast iron of precisely the same composition, and the behavior of cast iron under high temperatures. Standardization work also was considerably advanced.

Publish German-English Dictionary

A new, enlarged and improved edition of the association's foundry handbook, *Giesserei-Handbuch*, was completed. A German-English foundry dictionary also was issued which supplied an aid hitherto lacking to the German foundryman visiting England or America, or to the English or American foundryman visiting Germany. Desire for a knowledge of English among members of the industry also was met by the institution of lectures on technical English. A recognition of the importance of discussing technical problems of the industry directly with technical associations in other countries resulted in a large number of German foundrymen attending the London and the Detroit exhibitions.

After the adoption of the president's business report the general meeting passed a resolution conferring the Siegfried-Werner medal on Prof. Rudeloff, Berlin, in recognition of his great services in the technical sphere of foundry work. Following the transaction of the usual business, Dr. Geilenkirchen, Dusseldorf, the business director of the association, delivered a report on "The Economic Year 1925-26."

A paper by Dr. Kuhnel on "Some Results of Tests on Fire Bars," after dealing with investigations carried out by previous authors, gave the results of tests carried out by the state railways in collaboration with foundry experts. Fire bars containing 0.25 per cent, 0.40 per cent and 0.65 per cent phosphorus were used for the purpose, as well as bars such as those employed in practice which contain about 1 per cent phosphorus, some with a hardened surface and some with a protective coating. It was found that under the influence of heat there were serious alterations in structure which in some cases affected the whole of the bar. Generally three zones were discovered; an upper zone, which under working conditions is apparently in an almost fluid state and in which the sulphur from the coal penetrates. This is followed by a zone of transition with a varying structure, and in the center is a third zone which under the influence of heat has been converted into ferrite. The breaking-up process of the fire bar begins in the upper zone. To some extent the constituents of the coal ash helped to dissolve the cast iron and tended to disintegrate the bar. The author stated that it is difficult to obtain uniform results in these tests; not only do the results vary from one bar to another but different stages of disintegration have been observed in individual fire bars.

Herr Erbreich presented a paper on "The Present Position of Drying Stoves for Molds in Iron and Steel Foundry Practice." The author alluded to a paper which was read during the Hamburg exhibition last year in which the most important points were, the charging of the ovens, and the verifications of the heat consumption necessary for the evaporation of the water. He stated that following the researches made at that time the Krupp-Grusonwerk, Madgeburg, altered its drying ovens, increasing the charging to the maximum, with the result that a financial saving of 89 per cent was effected, as compared with the prewar practice. Countertests were effected at the Tanger Foundry and the following conclusions were obtained: (1) The complete combustion of the fuel must be obtained and forced draught introduced. (2) Temperature must be increased as rapidly as possible in or-

der to reduce the heat losses. (3) The ovens and oven doors must be insulated well. (4) The use of pyrometers has been found essential. (5) Firing must be conducted in such a way that after it is finished and the ovens are closed a temperature of at least 100 degrees Cent. will be found in the ovens next morning. In recent practice drying stoves have been equipped with regenerators, the gas flue being placed beneath the hearth. The subject of core-drying stoves also was discussed by Herr Erbreich who showed a number of photographs of American drying-stove plants.

Dr. Lischka, German foundry association, Dusseldorf, contributed a paper on "The Determination of Piece-work Time by Time and Work Studies," which described the investigations made by a committee which was formed by the German foundry association. Study of piece-work time has been made in relation to molding, core making, casting, stripping and cleaning. Examples of the principles which have been investigated were given relating to hand molding and to machine molding. A work-recording clock devised by Prof. Poppelruter gives automatic registration and the diagrams obtained can be utilized in the form of graphs or tables.

Special observation sheets are reserved for recording lost time and other sheets for working out results of machine and hand molding. It is claimed that this research work is an advance toward improvement in the determination of piece-work time in foundries and give a definite basis to figure the costs of manufacture.

Size of Charge Influences Analysis

BY RALPH H. KNIGHT

THE proper size of the charge for the cupola has been a constant source of debate among foundrymen, foundry experts and men of science. Standard charges as yet have not been reached, but no doubt at some time in the future a series of standard charges will be devised for the various sizes of cupolas now in daily operation.

A method for checking the cupola bed by charting the operation was described in an article in the March 1 issue of THE FOUNDRY. The same method may be applied exactly to charges. All thought was devoted to the cupola bed in the previous article, as it was assumed that the charges were of the right size for the particular operation.

The two heats which were charted were run on the same bed height. The height used was that considered suitable for the 1200 pound charge and 240 pound coke split. To determine the type of curve that would result when using a smaller charge, both the charge and the coke were cut in half. Of course this is an extreme case for ordinary practice, but the differences in the curves shows the varied results that may be obtained by having the charge too small. Notice the lines of parallelism in Fig. 1, and the ups and downs of the charges. This indicates an intermelting of charges and an inconsistent practice. Fig. 2 shows an even and uniform melt.

An analysis of the small charge showed the carbon and the silicon irregular. The original was calculated at 3.20 carbon and 2.65 silicon. A consistent analysis was secured when the largest charges were used. The manganese and phosphorous were as calculated in each case.

Resume Meetings

Monthly gatherings of the Pittsburgh Foundrymen's association resumed with the first meeting of the season at the Fort Pitt hotel Sept. 20. Phelan McShane, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., gave an address on using electricity in the foundry as applied to machinery, core ovens and furnaces. The meeting was presided over by Lawrence V. Stevens, Locomotive Stoker Co., president, and C. D. Carey, Verona Steel Castings Co., vice president. The Pittsburgh association will entertain the foreign guests of the American Foundrymen's association in Pittsburgh Oct. 8 and 9. A banquet at the Fort Pitt hotel is scheduled for Saturday evening, Oct. 9.

Alfred Box & Co. Inc., Philadelphia, manufacturer of cranes and hoists, has changed its name to Box Crane & Hoist Corp., to better fit the name to the product. No change is made in officers, who remain the same as for the past eight years.

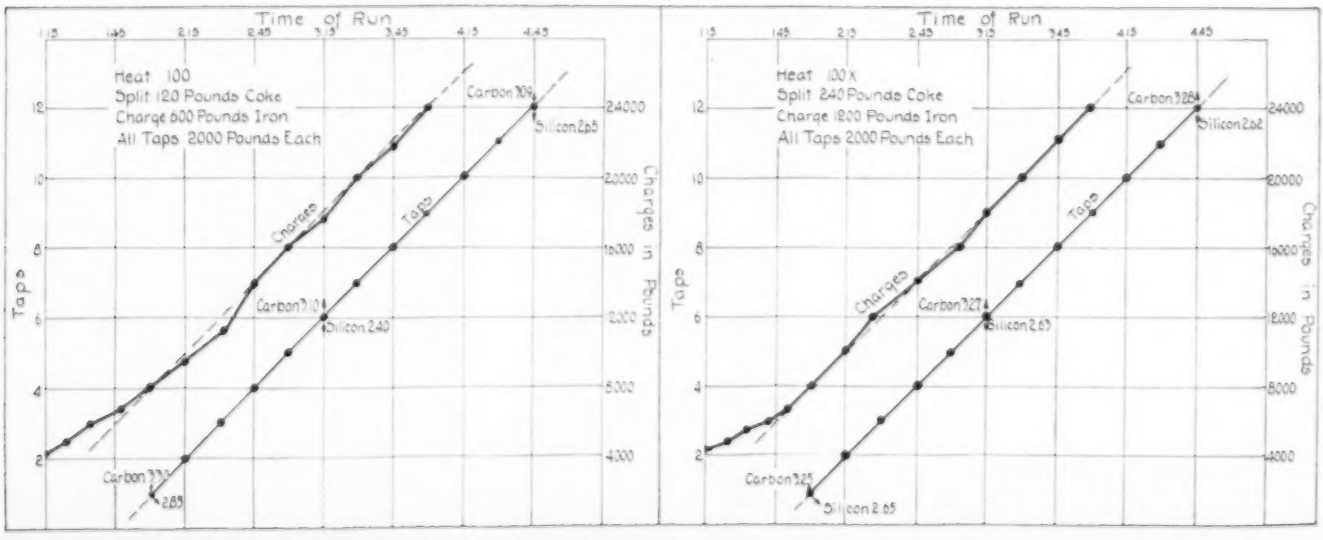


FIG. 1—AN INTERMELTING OF CHARGES WAS NOTED WITH THE SMALL CHARGES. FIG. 2—THE SMOOTH CURVE INDICATES GOOD PRACTICE

Milestones in Foundry Progress

As Recorded in the October Issues of THE FOUNDRY, Thirty, Twenty and Ten Years Ago

1896

GROVER CLEVELAND

MEETING for the first time after the great convention which inaugurated the American Foundrymen's association, the Philadelphia Foundrymen's association on Oct. 7, 1896, covered a wide variety of subjects ranging from the distribution of the remaining portion of the entertainment fund to the impending threat of free silver at the approaching elections.

* * *

Then as now, business men were censured severely for neglecting the duty of voting.

* * *

In the closing discussions the subject of costs was mentioned. With Philadelphia ranking the lowest in the country, the price of machinery castings was given as from 1¾ cents to 2 cents a pound. Francis Schumann, the recently elected first president of the American Foundrymen's association gave his costs as 1 32/100 cents with the melted iron costing ⅞ cents a pound.

* * *

One brave soul spoke of his cost system, which consisted of taking the total of the previous year's pig iron, coal and coke costs and adding that to the total of sand, labor and so forth and dividing that by the tonnage of castings, which gave a figure for the year following. The original method of finding costs by GUESSTIMATING.

* * *

Joe Johnson is one of those fellows who says he can buy castings cheaper than he can make them, and he is speaking the naked truth. If Mr. Johnson would make a set of flasks for patterns which he could use an indefinite number of times, his molders would be able to mold the greater part of the time, instead of doing carpenter work and spoiling good lumber.

Frank's Korner.

* * *

A full account of an accident at the South Brooklyn Steam Engine Works, South Brooklyn, N. Y. recounted how a yellow brass marine pump plunger, a hollow casting which was preheated and then struck with a sledge to break it into charging size, exploded. Expansion of entrapped gas or moisture resulted in the maiming of two workmen.

* * *

RHYMED REMINDERS

Robert Masters, veteran of another age,
Oft has told of hollow shot from the Civil war,
Thrown in the furnace to save the charging score.
His warning sharp and spoken like a sage,
Says, "Stop! Charge nothing hollow, 'til a vent you bore."

A. V.

* * *

A foundryman of long experience advised newcomers to choose a staple article, a necessity for manufacture. He said, "In my business, I have found that the first thing the public begins to economize in when hard times come is cast-iron lions."

* * *

The foundry at the Washington Navy Yard was being rebuilt.

1906

THEODORE ROOSEVELT

THE chemical laboratory had grown to sufficient recognition to entitle it a photographic presentation on the first page of the Oct. 1906 issue in a description of the Steel Foundry Co., Cincinnati.

A general discussion on the value of fluor spar as a flux was in progress.

* * *

A supplementary report of the British foundry association meeting in Middlesbrough contained frequent reference to the opinion of Prof. Thomas Turner, the recipient of the Joseph S. Seaman medal at the Detroit convention of the American Foundrymen's association.

* * *

S. T. Johnston, recently elected vice president of the American Foundrymen's association, as announced at the Detroit convention, in 1906 was chosen president of the Foundry Supply association.

* * *

No. 2 foundry iron was selling at $16 a ton, Birmingham.

* * *

The Philadelphia Foundrymen were starting plans for entertaining the American Foundrymen's association at the following annual convention to be held in June, 1907.

1916

WOODROW WILSON

J P. PERO, then of the Missouri Malleable Iron Co., E. St. Louis, Ill. was chosen president of the American Foundrymen's association at the Cleveland convention of the organization which is detailed in full in the Oct. 15, 1916, issue of THE FOUNDRY. The total registration reached the then unprecedented total of 1257.

* * *

Jesse L. Jones was the president of the American Institute of Metals and W. M. Corse was secretary.

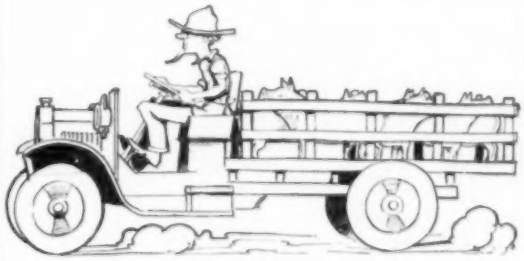
* * *

A new safety code for foundries was presented. This had been offered by the A. F. A. committee at the convention.

* * *

These were the busy times, just preceding our entry into the war. Yet foundrymen found time to attend and profit from the convention.

Faked Foundry Facts



A Pig Machine

The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ Is Variety the Spice of Life??

ONE noticeable feature in the advancement of the various industries has been the variation in sizes and types of the same products made by different manufacturers. The variations in size were due in a few instances to the desire of the manufacturer to make something slightly different than his competitor, but in the majority of cases the cause may be traced to the designer or engineer who specified certain definite sizes, not because of any inherent quality of those particular sizes, but simply because they did not or would not employ sizes already manufactured. Due to this lack of foresight, the number of sizes of manufactured articles has increased all out of proportion to actual needs.

A POINT that should give designers, engineers and others concerned, cause for hesitancy before embarking on a change or new project is that nearly 80 per cent of the business done is in 20 per cent of the varieties offered. This figure was obtained from a survey conducted by the division of simplified practice of the department of commerce on some 55 different materials. The man in the street will have as always, a ready remedy for such conditions. His brilliant cure-all will be to have the manufacturer stop making the sizes that are not in much demand. On the face this proposal apparently is plausible, but it is easier said than done. Every manufacturer's needs must carry the various sizes even though the demand for certain sizes is slight. Otherwise he may lose business because the buyer will come to the conclusion that the manufacturer does not have this and that, but his competitor has, so give him all the business.

MANUFACTURERS gladly would have reduced the number of sizes long before because the greater the variety, the higher the expense of conducting business, but it has been only recently that the manufacturers could get together on a common basis and agree on the particular sizes to be eliminated. Most of the credit is due to the newly formed division of simplified practice of the department of commerce which conducted numerous surveys and called the manufacturers together. So far over 55 completed simplifications have been made with an average elimination of 80 per cent. Savings estimated by leaders in different fields range from $1,000,000 per year in paving bricks to $200,000,000 per year in lumber. Bulletins are published on the recommendations for various materials and manufacturers and buyers can do much to aid in advancing simplified practice by placing their orders in terms of the recommended practice.

¶ Bring Them Together

NOTHING is easier than to damn by word or thought someone with whom you are not on familiar terms and whose apparent attitude may not accord with your own. Recently much discussion has been heard where foundrymen gather relative to their opinion of present day blast furnace operation. One may assert positively that scrap and even borings charged into blast furnaces are ruining the resulting foundry iron and that his troubles may be traced to this practice. Another deplores the lack of uniformity in mixtures despite satisfactory furnace analyses furnished by the pig iron producer. The latter may state that when he orders a 1.25 silicon he gets a carload made up of half 1.50 and the remainder 1.00 per cent silicon and that this purely synthetic mixture may be delivered in his yard so that he picks up the component pigs just when he does not want them.

SINCE unfamiliarity with the furnaceman's problems may in some measure cause this rankling, and since much valuable information probably would come from a meeting of minds on the subject, would not some open meeting between foundry iron producer's and foundrymen be in order? Why should not the American Foundrymen's association find this topic of sufficient interest to arrange a session or a round table at the next annual convention, where these various axes may be ground to their former fine edge.

Trade Trends in Tabloid

WITH building construction, automobile building and the manufacture of varied classes of machinery, all large consumers of castings, reporting increased activity, the outlook for the foundry industry this fall is bright. Keen competition continues to limit the margin of profits, and the bearing down on prices by buyers in all of these lines constitutes the only cloudy feature in this prospect. The Ohio State Foundrymen's association reports operations at 87.6 per cent of normal with stocks on hand averaging 84.1 per cent. Nonferrous foundries in that state are not quite so active as the gray iron shops. The brass foundry melt is reported at 79 per cent of normal for August.

Building construction showed a decided upward turn in August, while the continued high rate of automobile production pointed to a new yearly record for 1926. The farm implement outlook is good, according to reports from the mid-west sections, and tractor sales are improving in the rural centers. Jobbing foundries note an increase in orders and are busy, although the requirements in practically all cases are for small lots of castings for immediate delivery. Despite a recent high record for freight car loadings and a slow but decided drop in the surplus cars in good order, railway buying still is quiet. In the seven days ending Sept. 4, a total of 1,151,346 freight cars were in service.

RAW MATERIAL PRICES

Iron

Sept. 22, 1926

No. 2 foundry, Valley	$17.50 to 18.00
No. 2 Southern, Birmingham	21.00
No. 2 foundry, Chicago	21.00
No. 2 foundry, Philadelphia	22.26 to 22.39
No. 2 foundry, Buffalo	20.00
Basic, Valley	17.50 to 18.00
Basic, Buffalo	19.00
Malleable, Chicago	21.00
Malleable, Buffalo	20.00

Coke

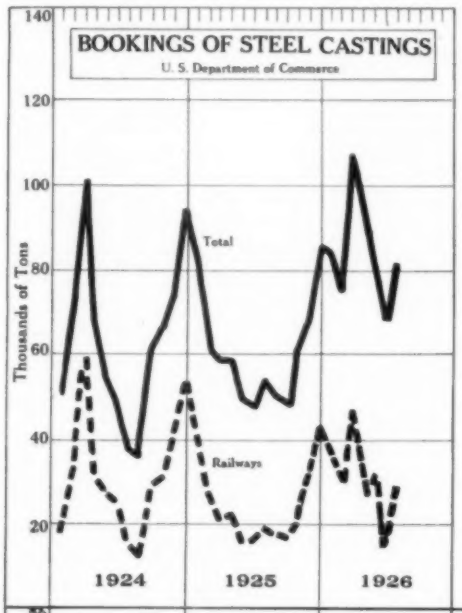
Connellsville foundry, coke	$4.00 to 4.50
Wise County foundry coke	4.50 to 5.00

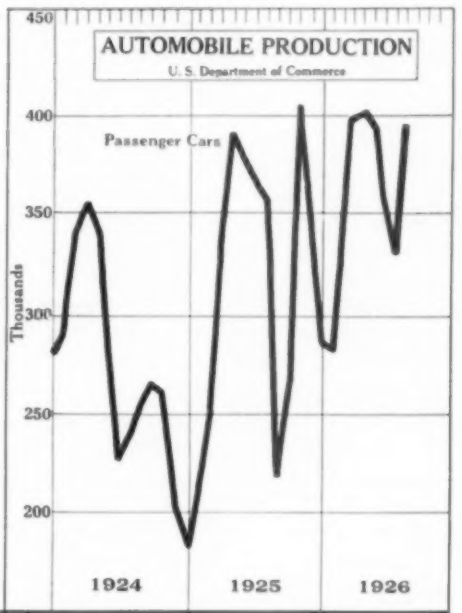
Scrap

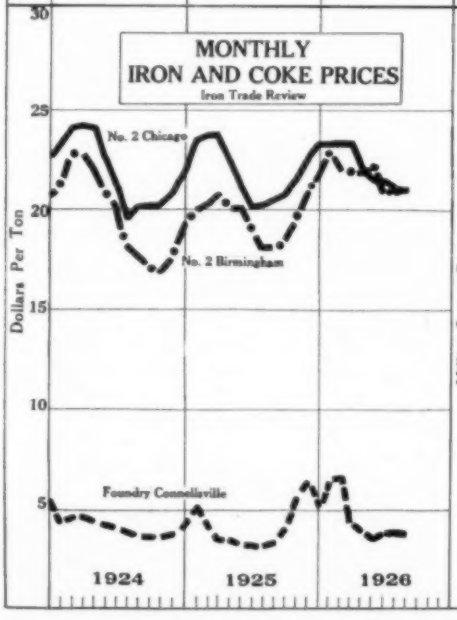
Heavy melting steel, Valley	$18.00
Heavy melting steel, Pitts	18.00 to 18.50
Heavy melting steel, Chicago	14.00 to 14.50
Stove plate, Chicago	14.75 to 15.00
No. 1 cast, New York	14.50 to 15.00
No. 1 cast, Chicago	17.00 to 17.50
No. 1 cast, Philadelphia	18.00 to 18.50
No. 1 cast, Pittsburgh	16.00 to 16.50
No. 1 cast, Birmingham	16.50 to 17.00
No. 1 cast, Buffalo	16.75 to 17.25
Car wheels, iron, Pittsburgh	16.50 to 17.00
Car wheels, iron, Chicago	15.25 to 15.75
Railroad malleable, Chicago	17.50 to 18.00
Agricultural, mall., Chicago	15.25 to 15.72
Malleable, Buffalo	17.50 to 18.00
Railroad Malleable, Pitts	18.50 to 19.00

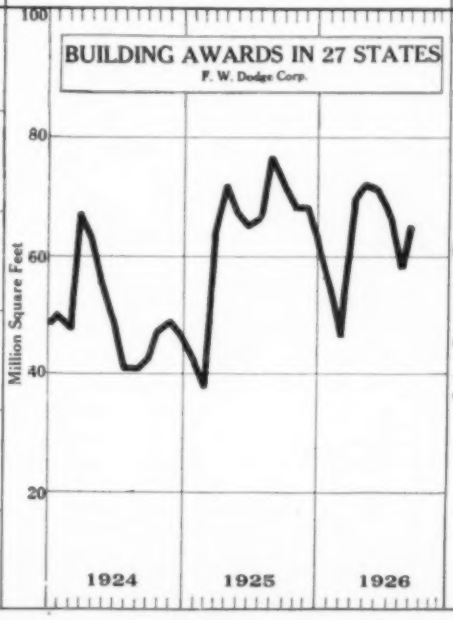
Nonferrous Metals

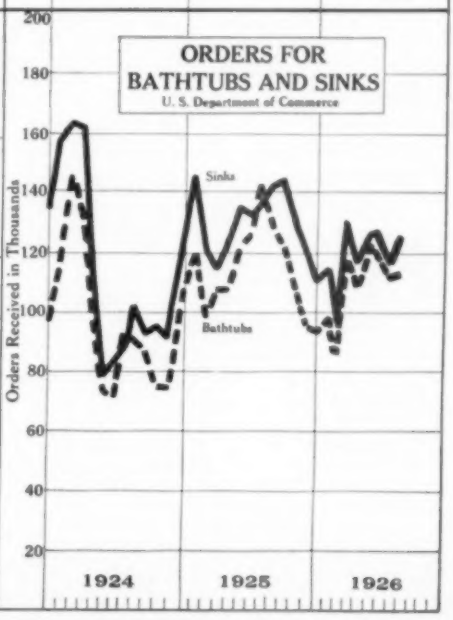
	Cents per pound
Casting copper, refinery	13.85
Electro copper, refinery	14.30
Straits tin	70.00
Lead, New York	8.75
Antimony, New York	13.50 to 13.75
Nickel, electro	39.00
Aluminum, No. 12, prod'rs	26.50
Aluminum, No. 12, remelt	22.50 to 23.00
Zinc, E. St. Louis, Ill.	7.47½











Comings and Goings of Foundrymen

WALTER L. SEELBACH, vice president, Forest City Foundry & Mfg. Co., and secretary-treasurer, Walworth Run Foundry Co., Cleveland, was re-elected president of the Ohio State Foundrymen's association at the convention held in Cincinnati Sept. 17-19. Mr. Seelbach was educated in the schools of Cleveland and was graduated from the Case School of Applied Science with a degree in civil engineering in 1910. Immediately upon leaving school he became connected with the Walworth company. He also is chairman of the finance committee of the Cleveland committee to entertain the foreign delegates to the American Foundrymen's convention during their stay in Cleveland. C. C. Smith, secretary-treasurer, Toledo Steel Casting Co., Toledo, O., was re-elected vice president of the association. More than 22 years ago, Mr. Smith started with the Toledo Steel company as pattern clerk. Later he worked in various positions including that of assistant manager. A. J. Tuscany, Cleveland, was re-elected secretary-manager of the Ohio State Foundrymen's association.

F. B. Williams, who has been associated with Walker & Pratt Mfg. Co., Watertown, Mass., for seven years has resigned his position as assistant superintendent and will join the staff of the Curtis Publishing Co., Philadelphia. A. E. Stevens will succeed Mr. Williams as assistant superintendent.

Louis A. Way has been made president of the Sharon Foundry Co., Wheatland, Pa. For many years he was superintendent of the Duquesne Steel Foundry Co., and later held the same position with the Lewis Foundry & Machine Co. He more recently was connected with the Mesta Machine Co., Homestead, Pa.

L. S. Harding, for several years employment manager and director of training for the Worthington Pump & Machinery Corp., East Cambridge, Mass., has been appointed industrial training advisor for the Associated Industries of Massachusetts. Mr. Harding also will continue his activities with the Worthington company.

Franz Hofmeier, foundry engineer, Gesellschafter der Eisengiesserei Carl Luber & Sohn, Vienna, Austria, the official representative of the Austrian Foundrymen's association at the Detroit convention Sept. 27 to Oct. 1, has arrived in the United States and will spend several months in this country visiting and inspecting foundries. Mr. Hofmeier's firm manufactures stoves, small internal combustion engines and pumps.

G. V. Soborigi, who was elected president of the Taylor-Wilson Mfg. Co., McKees Rocks, Pa., formerly was connected with the American Steel & Wire Co., Schoenberger Works, Pittsburgh, in an engineering capacity and lately has been chief engineer of the A. M. Byers Co., Pittsburgh. He succeeds J. R. Bradley.

Miles E. Johnson, president of the Johnson Brass & Aluminum Works, Dundee, Mich., which recently ceased operations, was connected with the Doehler Die Casting Co., Toledo, O., for five years and was chief engineer for the Railway Materials Co. Toledo, O., for two years.

Carl G. Schluederberg, Pittsburgh, has been appointed general manager of the George Cutter Co., South Bend, Ind., a subsidiary of the Westinghouse Electric & Mfg. Co. East Pittsburgh, Pa., according to an announcement made by F. A. Merrick, vice president and general manager of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Mr. Schluederberg received his education in the Kiskiminetas Springs preparatory school and Cornell university. He holds the degree of doctor of philosophy from that university. He is a member of the National Electric Light association, the American Institute of Electrical Engineers, the American Chemical society, and the American Electrochemical society.

Changes Are Made

Reorganization of the general engineering department of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., was necessitated by the reallocation of several engineers. Four engineers were made managers, as follows: F. C. Hanker, manager of central station engineering; S. B. Cooper, manager of railway engineering; G. E. Stoltz, manager of industrial engineering, and W. E. Thau, manager of marine engineering. S. A. Staege, formerly section engineer, paper mill section, has been appointed industrial engineer. Other appointments were: Central station engineering, C. A. Powell, generating station; R. D. Evans, transmission and C. A. Butcher, substation; Railway engineering, H. K. Smith, heavy traction; G. M. Woods, light traction, and A. H Candee, gas-electric traction; Industrial engineering, E. M. Bouton, elevator; C. W. Drake, general industrial; G. T. Guilford, textile; C. H. Matthews, mining; O. Needham, steel mill; J. W. Speer, material handling; W. W. Spratt, paper mill, and E. B. Dawson, electrochemical and electrometallurgical. N. W. Storer was appointed consulting railway engineer in charge of group handling of diesel-electric locomotives and rail cars.

Welders Will Meet

Northern New York section of the American Welding society will hold its first meeting of the 1926-27 season at the Pittsfield works Sept. 29. General Electric Co., Pittsfield, Mass. At 2:30 p. m. an inspection trip will be taken through the departments where various welding operations are carried on. After the trip a dinner will be served in the works restaurant. In the technical session at 7:30 p. m. H. W. Tobey, General Electric Co., Pittsfield, will read a paper on electric resistance welding.

Incorporate Company

Incorporation of the Pottstown Machine Co., Pottstown, Pa., builder of special automatic machinery, has been effected to more satisfactorily carry on the business which previously had been conducted as a proprietorship. The company was established in 1905 by John R. Saylor, who was proprietor until July 1 when he incorporated. Officers are Mr. Saylor, president, E. E. Saylor, vice president; John G. Herndon Jr., Philadelphia, secretary and W. H. MacDade, treasurer. The officers comprise the board of directors.

Publishes New Booklet

Sands, clays, kieselguhr, fullers earth, graphite, talc, zirconia and other economic minerals are described in a booklet published by A. L. Curtis,

Chatteris, England. The description and characteristics of sands for abrasive, molding, filling, building, and many other purposes occupies the greater portion of the booklet. The booklet is illustrated.

Makes Green Sand Cores for Soil Pipe

Question: We understand that foundries in the United States engaged in the manufacture of soil pipe castings have adopted an ingenious type of machine for making the green sand cores. We are contemplating the manufacture of these castings in this country and will appreciate your kindness in sending us the address of the firm which makes the machine, or a description of the machine so that we may build one for our own use.

Answer: So far as we know each firm engaged in the manufacture of soil pipe castings in this country has constructed its own machine for making the cores. They all are built on the same general principle, but minor details representing individual preference of each foundryman, are incorporated in each machine. In large installations, sand is delivered to the hopper through a power operated bucket elevator. In smaller plants the hopper over each floor is filled by throwing sand into it with a shovel as often as it becomes nearly empty. In the large plants two men working steadily under a central machine make all the cores required for 10 or 12 floors. In the small plants a simplified type of machine erected at the head of each floor is employed by the pair of molders working on that floor to make their own cores. The number of cores and molds constituting a day's work varies with the size of the casting. Two men with two 4-inch patterns make 76 castings a day. This includes making the molds, cores, pouring the iron, shaking out the castings and stacking them, and cutting over the sand.

The cores are swept in green sand on cast iron barrels and the only function of the core machine is to spray the sand on to the barrel with sufficient speed and force to make it stick without becoming too dense and hard. Naturally this point only may be determined by experiment. Sand varies in different localities and a degree of density in one sand that would cause no trouble, easily might cause the iron to bubble in another mold and core made from a different sand. This feature also bears directly on the question of selecting the most suitable type of arbor. A single row of vent holes along the top of the arbor has proved quite adequate in the operation of some foundries. In other foundries where the sand is *closer* additional rows of vent holes have been required in the arbors.

In its simplest form the machine is made up of two parts, the stand on which the arbors are mounted and the hopper which holds the sand. The hopper is located directly above the arbor and at the proper height, as previously explained, to deliver the sand with the correct speed to make it adhere to the arbor. The stationary hopper is the full length of the arbor. In cross section it is *V*-shaped. The apex of the *V* forming the opening through which the sand falls in a narrow stream on to the arbor. The hopper is equipped on the inside near the lower opening with an oscillating riddle operated by a suitable handle on the outside. In practice one man revolves the arbor, while the second man shovels sand into the hopper and then agitates the riddle. The arbor is machined at both ends and fits in two guides corresponding to the machine ends of the flask. A suitable *strike* attached permanently to the stand removes superfluous sand and produces a core true to size in about 10 or 12 revolutions of the arbor. The arbor is turned by a tapered plug equipped with a crank handle. The plug is pushed into the open end of the arbor and held by friction. It easily is disengaged when the core is made.

New Firm Organized

Higby-Reynolds Silica Co., Columbus, O., has been organized to take over the business of the Higby Canyon Sand Co., and the E. J. Reynolds Sand Co. This firm will produce steel molding sand, core sand, sand for sandblast and other purposes. The officers of the new company are: T. V. Taylor, Columbus, O., president; A. S. Hindman, Chicago, vice president; H. C. Cary, Utica, Ill., vice president; C. J. Niesen, Utica, Ill., secretary; E. W. Weaver, Ottawa, Ill., general manager.

Foundry Association Directory

The Buffalo Foundrymen
Buffalo

President, J. McARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 146 Chandler street. Meetings the third Wednesday of the month at 146 Chandler street.

Chicago Foundrymen's Club
Chicago

President, CHARLES L. LARSEN, Armour Institute of Technology, 3200 Federal street, Chicago; secretary-treasurer, E. C. BARRINGER, THE FOUNDRY, 1147 Peoples Gas building, Chicago. Meetings second Saturday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, FRED W. STICKLE, Capitol Foundry Co., Hartford, Conn.; secretary, C. S. NEUMANN, Union Mfg. Co., New Britain, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association
Detroit

President, ROBERT G. CRAWFORD, Atlas Foundry Co., 131 South Artillery street, Detroit; secretary, RUSSELL M. SCOTT, Packard Motor Co., 1580 East Grand boulevard, Detroit. Meetings third Thursday in each month at the Union League club, 35 Grand River avenue, Detroit.

Metropolitan Brass Foundry Association
New York

President, THOMAS HARPER, Thomas Harper, 204 Lafayette street, New York; secretary, WM. E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meetings second Wednesday in each month at the Building Trades club, 34 West Thirty-third street, New York.

Newark Foundrymen's Association
Newark, N. J.

President, J. L. CARTER, Barlow Foundry, Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meetings called by president.

New England Foundrymen's Association

President, H. P. BLUMENAUER, Arcade Malleable Iron Co., Worcester, Mass.; Secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio State Foundrymen's Association

President, WALTER L. SEELBACH, Walworth Run Foundry Co., 2488 West Twenty-seventh street, Cleveland; secretary-manager, ARTHUR J. TUSCANY, 5713 Euclid avenue, Cleveland.

Philadelphia Foundrymen's Association
Philadelphia

President, WALTER WOOD, R. D. Wood & Co., Philadelphia; secretary HOWARD EVANS, J. W. Paxson Co., Luzerne and D streets, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association
Pittsburgh

President, LAWRENCE V. STEVENS, Locomotive Stoker Co., N. E. Pittsburgh; secretary-treasurer, WM. J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association
Davenport, Iowa

President J. H. DIEDRICH, Blackhawk Foundry & Machine Co., Davenport, Iowa; secretary-treasurer, A. D. ZIEBARTH, Davenport Foundry & Machine Co., Davenport, Iowa. Meetings the third Monday evening of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

Southern Metal Trades Association
Atlanta, Ga.

President, GEORGE B. COCKER, Gastonia, N. C.; secretary-treasurer, W. E. DUNN JR., Healey building, Atlanta, Ga.

Tri-City Technical Council
Moline, Ill.

Chairman, H. BORNSTEIN, Deere & Co., Moline, Ill.; treasurer, MAX SKLOVSKY, Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association
Cincinnati

President, HAROLD P. RITTER, John A. Oberhelman Foundry Co., 3323 Colerain avenue; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

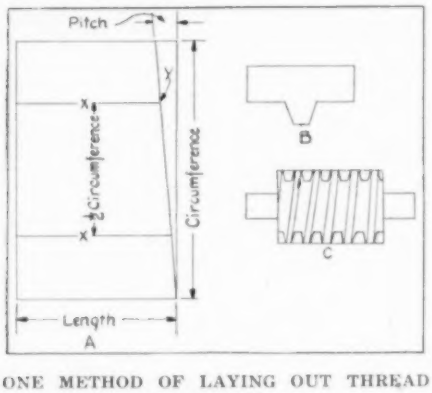
Twin City Foundrymen's Association
Minneapolis-St. Paul

President, J. A. TEACH, Minneapolis Steel & Machinery Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, So., Minneapolis. Meetings monthly at the Athletic club.

Lay Out Thread on Worm Pattern

Question: I shall appreciate any instruction you can give me on how to make a pattern for a worm. Also can you tell me where I can secure a reliable book devoted exclusively to the subject of patternmaking.

Answer: Screw and worm patterns usually are parted longitudinally through the center. The two halves are pinned in the usual manner and turned to a cylinder the diameter of the outside of the worm with the prints or hubs as the case may be, attached. The method for forming an ordinary worm is shown in the accompanying illustration. A piece of fairly heavy clean paper as wide as the worm is long and in length equal to the circumference is used to obtain the pitch angle for laying out the spiral or helix. To insure straight edges and sharp corners on the paper it is advisable to do the cutting with a sharp knife. The pitch or distance from the center of one thread to the center of the next thread is measured



ONE METHOD OF LAYING OUT THREAD AND TEMPLET

and marked on one of sides representing the length of the worm. The line *y* Fig. *a* is drawn connecting the point with the lower corner and the paper is cut along this line to serve later as a templet. Parallel lines *X X* are drawn equal distances from the ends of the paper and with a distance between them equal to half the circumference of the pattern. The screw sections and the pitch angles are laid out on the joint of one half of the pattern. The lines representing the tops of the threads are carried across the joint surface with sharp knife lines as shown at *C*. The paper pattern then is stretched tightly around the half pattern with the two lines *X X* coinciding with the joint edges of the half pattern. The spiral line connecting the layout lines on the joint is drawn around the outside of the pattern with a sharp pencil guided by the line on the paper templet. When the lines from one end to the center have been drawn it will be necessary to start at the other end as there is not enough bearing surface for the templet on the pattern. After one half pattern is laid off, the two halves are put together and the lines are continued around the second half.

Another method and one that probably is more convenient is to lay out all the lines on a paper pattern and then wrap it around the pattern. The ends are fastened with glue or thumb tacks and the lines are transferred to the pattern cylinder by a tracing wheel. If the paper is glued on it may be allowed to remain until after the pattern has been roughed out. Several books have been published on the subject of patternmaking. Patternmaking, by Joseph A. Shelley may be ordered through THE FOUNDRY for $3.00.

Compare Iron and Steel Cleaning Methods

Question: What are the principal points of difference between cleaning iron and steel castings?

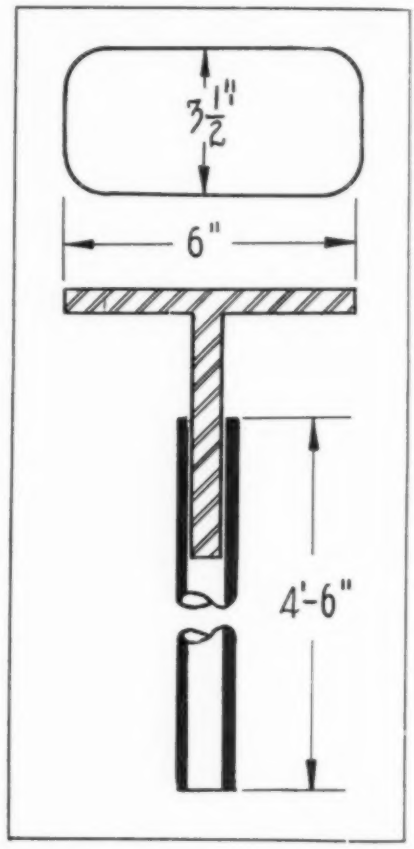
Answer: In many respects the methods and equipment employed for cleaning steel castings are the same as those to be found in iron foundries. Many steel castings are cleaned as easily as iron castings, but in the great majority of cases the work is more difficult and takes more time. This is due to two principal causes. On account of the higher temperature of liquid steel the sand in the mold fuses and burns on to the face of the casting. Large sink heads must be placed on steel castings to prevent shrinkage and a considerable amount of work is involved in the cleaning room in removing these heads. On certain classes of castings the heads are attached in such a manner that they may be knocked off with a sledge hammer, but in the greater number of cases they must be removed in some other manner. Formerly the heads were sawed off and this method is employed to some extent up to the present, but the almost universal practice now is to cut the heads off either with an oxyacetylene or an electric torch.

Nearly all steel castings are annealed and this feature adds to the time required to handle them and to their total cost. They are given a rough cleaning and the larger heads are removed before they are placed in the annealing oven. They are ground, chipped and inspected after they are removed. Small steel castings are cleaned in tumbling barrels and large castings are sandblasted, but as a general rule either process consumes more time than in the installations where it is applied to iron castings.

Develops an Effective Skimmer for Ladles

By Michael R. Burns

Supplying 32 bench molders every day with the ordinary type skimmer made from ½-inch steel rod, 4 feet long entails the loss of approximately 40 feet of rod per day or over 12,000 feet per year. In a steel foundry, the rod is straight at the beginning of the heat, but gradually collects a ball of slag and metal on one end before the heat is poured. About 8



DETAIL OF SKIMMER CONSTRUCTION

inches is cut from the end of the rod for three successive mornings and then as the rod is too short for a skimmer it is thrown into the pile for use by the coremakers. The skimmer shown will last indefinitely. After it has been in use for some time the accumulated material is struck with a hammer and immediately falls off. The head is a thin steel casting provided with a short stem slightly tapered toward the end. The handle is a section of gas pipe 4 feet 6 inches long. The stem is forced into the handle until it becomes tight and after that it requires no further attention.

Anticipate Increased Buying

Interest Shown in Equipment Exhibition and General Increase in Sales in September Indicate Further Betterment in Orders

ALTHOUGH considerable buying of equipment was noted in some quarters in September, it is believed by men of the trade that many buyers held off purchases with the idea of inspecting various classes of equipment at the Detroit show. Manufacturers of equipment are rather optimistic over the prospects for the remainder of the year, due to the large number of inquiries coming out, the interest in the displays at Detroit, and to the upturn in orders noted since the end of the vacation season.

September foundry equipment sales promise to equal, if they do not exceed August's in the Pittsburgh area. Among the pending inquiries is that of the S. Morgan Smith Co., York, Pa., for a 96-inch cupola, a 25-ton reservoir ladle, a brass furnace, and a sand mixer. The Bethlehem Steel Corp. wants an electric furnace, and the Carnegie Steel Co. is in the market for two electric blowers. One or two cupola inquiries are pending, as are some sand mixers, electric hoists, blowers, together with inquiries for between 20 and 30 molding machines. The Westinghouse Electric & Mfg. Co. has issued its fourth quarter list of equipment needs for its various foundries.

While foundry operations have shown some improvement, buying of equipment in the East has been light. In fact, there has been little placed in the way of large units, a situation accounted for in part by the lack of new foundry construction. Cupola sales, for instance, have been practically nonexistent. Buying by foundries catering chiefly to railroad business appears the slowest this year.

The foundry equipment market in the Chicago territory has been exceedingly slack during the past two weeks, many interests report. Foundry equipment sales in New England during the past two weeks have shown but moderate improvement. Inquiry, however, is decidedly better and much buying now is in early prospect. The rate of melt in the district is gradually improving. A Massachusetts foundry is in the market for six molding machines for a plant extension.

BOSTON MARKET

Ladles

Barbour-Stockwell Co., Cambridge, Mass., pouring equipment from Alexander Haigh, Boston.

Sandblast Equipment

Union Mfg. Co., New Britain, Conn.; from the Pangborn Corp., Hagerstown, Md.

Sand Preparing Equipment

Manufacturers Foundry Co., Waterbury, Conn.; Connecticut Foundry Co., Rocky Hill, Conn.; Howe Scale Co., Rutland, Vt.; sand cutting machines from the American Foundry Equipment Co., Mishawaka, Ind.

Millbury Steel Foundry Co., Millbury, Mass., one; Plainville Casting Co., Westfield, Mass., one; William Duncan Co., Boston, one; sand separator and blender from the Royer Foundry & Machine Co., Wilkes-Barre, Pa., through Alexander Haigh, Boston.

PITTSBURGH MARKET

Core Ovens

Bessemer Gas Engine Co., Grove City, Pa., core oven equipment.

Cranes

Pittsburgh Plate Glass Co., Pittsburgh, one 5-ton from the Milwaukee Electric Crane & Mfg. Co., Milwaukee.

Dust Arrester Equipment

Lebanon Steel Foundry, Lebanon, Pa., from the Pangborn Corp., Hagerstown, Md.

Allegheny Steel Co., Brackenridge, Pa., two orders from the American Foundry Equipment Co., Mishawaka, Ind.

Furnaces

Railway Industrial Engineering Co., Greensburg, Pa.; two furnaces; Cochrane Brass Foundry, York, Pa., one brass furnace; from the J. S. McCormick Co., Pittsburgh.

Bessemer Gas Engine Co., Grove City, Pa., one aluminum tilting furnace from the Foundry Equipment Co., Cleveland, through Paul Hay, Pittsburgh.

Ladles

Clark Bros., Olean, N. Y., two geared buggy ladles, from the J. S. McCormick Co., Pittsburgh.

Molding Machines

Pittsburgh Engineering Co., Jeanette, Pa., six; Acme Steel Co., Glassmere, Pa., two; American Steel Foundries, Pittsburgh; Ludlum Steel Foundry Co., Ludlum, Pa.; one each from the Herman Pneumatic Machine Co., Zelienople, Pa.

Sandblast Equipment

Allegheny Steel Co., Brackenridge, Pa., two orders from the American Foundry Equipment Co., Mishawaka, Ind.

Sand Preparing Equipment

Kuebler Foundry Co., Easton, Pa.; Textile Machine Works, Reading, Pa.; sand cutting machines from the American Foundry Equipment Co., Mishawaka, Ind.

American Brake Shoe & Foundry Co., Pittsburgh; Coffield Washer Co., Dayton, O., sand sifters from the J. S. McCormick Co., Pittsburgh.

Mesta Machine Co., Pittsburgh, one sand mixer from the Blystone Mfg. Co., Cambridge Springs, Pa., through the J. S. McCormick Co., Pittsburgh.

Shakeout Equipment

Westinghouse Air Brake Co., Wilmerding, Pa.; Oil Well Supply Co., Oil City, Pa.; vibrator and shakeout equipment from the Stoney Foundry Engineering & Equipment Co., Cleveland.

Miscellaneous

Brown-Fayro Co., Johnstown, Pa., one hammer core machine from the J. S. McCormick Co., Pittsburgh.

Columbiana Foundry Co., McKeesport, Pa., four core racks; from the J. S. McCormick Co., Pittsburgh.

Bessemer Gas Engine Co., Grove City, Pa., core oven racks from the Erie Malleable Iron Co., Erie, Pa.

CHICAGO MARKET

Dust Arrester Equipment

Ben Sibbitt Iron & Foundry Co., Wichita, Kans.; Union Iron Works, Spokane; Hughes Tool Co., Houston, Tex.; from the Pangborn Corp., Hagerstown, Md.

Molding Machines

American Steel Foundries, Indiana Harbor, Ind.; Busch-Sulzer Bros. Diesel Engine Co., St. Louis; Yates American Machine Co., Beloit, Wis.; Power Iron Works, Pueblo, Colo.; from the Herman Pneumatic Machine Co., Zelienople, Pa.

Sandblast Equipment

Smith System Heating Co., Minneapolis; Johnson City Foundry Co., Johnson City, Tenn.; Denver Rock Drill Co., Denver; from the American Foundry Equipment Co., Mishawaka, Ind.

Great Northern Railway Co., St. Paul; St. Louis, San Francisco Railway Co., St. Louis; from the Pangborn Corp., Hagerstown, Md.

Sand Preparing Equipment

Flint Malleable Castings Co., Flint, Mich.; Letz Mfg. Co., Crown Point, Ind.; International Harvester Co., Chicago; National Malleable & Steel Castings Co., Chicago; Marine City Motor Castings Co., Marine City, Mich.; Illinois Foundry Co., Springfield, Ill.; Almont Mfg. Co., Almont, Mich.; International Harvester Co., Moline, Ill.; International Harvester Co., Richmond, Ind.; Franks Foundry Corp., Davenport, Iowa; Colgate & Co., Jeffersonville, Ind.; Nelson Bros., Saginaw, Mich.; East St. Louis Castings Co., East St. Louis, Ill.; Indiana Foundry Co., Muncie, Ind.; Knowles Foundry & Machine Co., Ottawa, Ill.; Anderson Engine & Foundry Co., Anderson, Ind.; Belle City Malleable Co., Racine, Wis.; National Malleable & Steel Castings Co., Cicero, Ill.; Des Plaines Foundry Co., Des Plaines, Ill.; sand cutting machines from the American Foundry Equipment Co., Mishawaka, Ind.

Shakeout Equipment

Wolff Mfg. Corp., Chicago; Griffin Wheel Co., Council Bluffs, Iowa; Standard Foundry Co., Racine, Wis.; John Deere Tractor Co., Waterloo, Iowa; shakeout and vibrator equipment from the Stoney Foundry Engineering & Equipment Co., Cleveland.

CLEVELAND MARKET

Cranes

Delco Light Co., Dayton, O.; 30-ton transfer crane from the Milwaukee Electric Crane & Mfg. Co., Milwaukee.

Dust Arrester Equipment

Barnes Mfg. Co., Mansfield, O., from the American Foundry Equipment Co., Mishawaka, Ind.

Cleveland Co-Operative Stove Co., Cleveland; from the Pangborn Corp., Hagerstown, Md.

Furnaces

National Foundry Co., Erie, Pa., one 3-ton electric furnace from the American Bridge Co., Ambridge, Pa.

Molding Machines

Alloy Cast Steel Co., Marion, O.; Hoover-Owens-Rentschler Co., Hamilton, O.; American Radiator Co., Buffalo; one machine each from the Herman Pneumatic Machine Co., Zelienople, Pa.

Sandblast Equipment

Pratt & Letchworth Co., Buffalo; New York Central railroad, Buffalo; Buick Motor Car Co., Flint, Mich.; from the Pangborn Corp., Hagerstown, Md.

Babcock & Wilcox Co., Barbertown, O.; Barnes Mfg. Co., Mansfield, O.; from the American Foundry Equipment Co., Mishawaka, Ind.

Dodge Bros., Detroit; table machine from the J. W. Paxson Co., Philadelphia.

Sand Preparing Equipment

Industrial Steel Castings Co., Toledo, O.; Ohio Steel Foundry Co., Springfield, O.; Gartland-Haswell-Rentschler Co., Dayton, O.; J. A. Oberhelman Foundry Co., Cincinnati; Standard Foundry Co., Buffalo; New Idea Spreader Co., Coldwater, O.; Superior Castings Co., Dayton, O.; from the American Foundry Equipment Co., Mishawaka, Ind.

G. & C. Foundry Co., Sandusky, O.; one sand separator and blender from the Royer Foundry & Machine Co., Wilkes-Barre, Pa., through the Mayor Fuel Saving Furnace Co., Cleveland.

Shakeout Equipment

Buick Motor Car Co., Flint, Mich.; Cadillac Motor Car Co., Detroit; Ferro Machine & Foundry Co., Cleveland, shakeout bails; Humphreys Mfg. Co., Mansfield, O.; vibrator and shakeout equipment from the Stoney Foundry Engineering & Equipment Co., Cleveland.

NEW YORK MARKET

Cranes

Bethlehem Steel Corp., Sparrows Point, Md., four 10-ton cranes from the Morgan Engineering Co., Alliance, O.

Dust Arrester Equipment

Deemer Steel Castings Co., New Castle, Del.; Metal Sprayers, Ltd., Auckland, New Zealand from the Pangborn Corp., Hagerstown, Md.

Molding Machines

American Abrasives Metals Co., Irvington, N. J., one from the Herman Pneumatic Machine Co., Zelienople, Pa.

Sandblast Equipment

M. W. Kellogg Co., Jersey City, N. J.; from the American Foundry Equipment Co., Mishawaka, Ind.

Sand Preparing Equipment

Sheridan Iron Works, Champlain, N. Y.; Brooklyn Brass Works, Brooklyn, N. Y.; American Abrasive Metals Co., Irvington, N. J.; Flockhart Foundry Co., Newark, N. J.; Fox Hill Foundry Co., Hoboken, N. J.; Worthington Pump & Machinery Co., Harrison, N. J.; one sand separator and blender each from the Royer Foundry & Machine Co., Wilkes-Barre, Pa., through Alexander Haigh, Boston.

Welsbach Co., Blackwood, N. J.; Bartlett Hayward Co., Baltimore; sand cutting machines from the American Foundry Equipment Co., Mishawaka, Ind.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Alabama Foundry Co., Birmingham, Ala., has been incorporated with $50,000 capital by S. E. Thomas, Brewer Dixon and D. E. Wade.

U. S. Radiator Corp., Dunkirk, N. Y., Homer Hosking manager, is considering plans for an addition to its plant.

Lynchburg Foundry Co., Radford, Va., will build an addition 65 x 160 feet to its fittings foundry.

Medart Co., St. Louis, manufacturer of power transmission machinery, will rebuild burned portion of its plant immediately.

Commerce Pattern Foundry & Machine Co., 2211 Grand River avenue, Detroit, will enlarge its foundry and machine shop and is seeking equipment for both.

Ritter Dental Mfg. Co., 404 West avenue, Rochester, N. Y., will build a 1-story foundry 60 x 140 feet. Foote & Carpenter, 718 Temple building, are architects.

Electro Steel Castings Co., Joplin, Mo., has been incorporated with $10,000 capital to operate a steel foundry, with electric furnaces, by C. B. Rogers, 612 West A street.

Johnson Bronze Co., New Castle Pa., D. J. Flaugherty president, South Mill street, will build a 3-story addition 45 x 153 feet and one story 50 x 53 feet.

Republic Die Casting Co., New York, has been incorporated with $60,000 capital by M. Ketcher, A. Bregman and B. Raymond. R. C. Birkhahn, 353 Fifth avenue, is attorney.

Active Stove Mfg. Co., Sinking Spring, Pa., has been incorporated with $5000 capital to manufacture stoves and ranges by J. Michael Hertlein, Reading, Pa.; Ephraim Witman and Harry Stott, Sinking Spring.

Butler Street Foundry & Iron Co., Chicago, H. Linder manager, 3424 Normal avenue, has let contract to Carl Bushnell, 133 West Washington street, for rebuilding after fire its 1-story foundry 60 x 270 feet. A. Epstein, 2001 West Pershing road, is architect. (Noted Sept. 1.)

Pullman Car & Mfg. Co., 79 East Adams street, Chicago, has let contract to Sumner-Sollitt Co., 307 South Michigan avenue, for a factory development at 111th and Langley avenue.

Parker White Metal & Machine Co., Erie, Pa., W. A. Parker manager, Twenty-third street, has let contract to W. S. Wood, 2017 Wayne street, for a 3-story addition to its plant, 60 x 100 feet. (Noted Sept. 1.)

General Foundries, Inc., Flint, Mich., recently incorporated with $150,000 capital by C. W. Bonbright, W. E. Fellows and J. M. Barringer, Flint, has let contract to Utley Construction Co. for first unit of a plant, about 30,000 square feet of floor space.

Bessemer Foundry & Machine Co., Bessemer, Ala., will build an addition to its plant here.

Price-Evans Foundry Corp., Chattanooga, Tenn., has been incorporated with $240,000 capital by H. F. Oriscom, Dyer Butterfield, B. Schoolfield, A. W. Tabor and W. D. Moon.

Diamond Foundry Corp. of Danville, Danville, Va., has been incorporated with 10 to 500 shares no par value by J. M. Morehead president, New York; Ira Darling secretary, Chicago; Frank Talbott Jr., Malcolm K. Harris and E. Walton Brown, Danville.

Wyomissing Art Bronze Co., Wyomissing, Pa., has been incorporated with $5000 capital to manufacture ornamental and architectural bronze and castings by Charles M. A. Frankhouser, 701 Holland square, West Reading, Pa., Ivar Carlson, and E. DeM. Frankhouser.

Green Bros. Inc., 218 West Main street, Hoopeston, Ill., have been incorporated with $50,000 capital to conduct a foundry and machine shop by William S. Green, Lucy F. Green, Grace A. Green, and H. J. Green. Dyer & Dyer, Dyer Fuller block, are correspondents.

Holly Carburetor Co., Detroit, George M. Holley president, Vancouver avenue and Pere Marquette railroad, has let contract to Culbertson & Kelly, 372 West Milwaukee avenue, for a 3-story foundry building 90 x 106 feet. Albert Kahn Inc., 1004 Marquette boulevard, is architect.

Bertram Machine Co.'s plant at Dundas, Ont., for several years operated as a Canadian branch of the Niles-Bement-Pond Co., New York, has been restored to Canadian ownership, with Bertram interests in control. The same interests have also acquired the plant of Pratt & Whitney Co., also of Dundas, Ont. New officers of the Bertram Machine Co. are: Henry Bertram president and general manager; James Young vice president; H. Graham Bertram secretary-treasurer; A. W. Parks chief engineer; G. H. Howard sales manager.

M. & H. Valve & Fittings Co., Birmingham, Ala., recently incorporated to manufacture steam and water valves, flanges and flange fittings, will start production Oct. 1. Its building is complete and equipment bought from receivers of the McNab & Harlin Mfg. Co., Paterson, N. J., is proceeding. J. W. Conway, Atlanta, Ga., is president and general sales manager, Whitfield Clark, Anniston, Ala., vice president.

New Trade Publications

STOP AND CHECK VALVES—An equalizing stop and check valve for boiler efficiency manufactured by Jenkins Bros., New York, is featured in a bulletin just issued. Its purpose is to give notice of the condition of steam pressure in each of a battery of boilers, indicating which needs firing, by making possible a separate pressure reading for each. It is fully illustrated.

INDUSTRIAL SIGNALS—Visual and audible signals for industrial purposes are described in a booklet by the Benjamin Electric Mfg. Co., Chicago. Twelve signaling circuits are shown and numerous other applications are described.